

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
6 November 2003 (06.11.2003)

PCT

(10) International Publication Number  
**WO 03/091035 A1**

(51) International Patent Classification<sup>7</sup>: **B41J 11/00,**  
3/407

(21) International Application Number: **PCT/JP03/05445**

(22) International Filing Date: **28 April 2003 (28.04.2003)**

(25) Filing Language: **English**

(26) Publication Language: **English**

(30) Priority Data:  
2002-127123 26 April 2002 (26.04.2002) JP  
2002-158983 31 May 2002 (31.05.2002) JP

(71) Applicant (for all designated States except US): **CASIO COMPUTER CO., LTD.** [JP/JP]; 6-2, Hon-machi 1-chome, Shibuya-ku, Tokyo 151-8543 (JP).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MOCHIZUKI,**

Yoshiaki [JP/JP]; 20-18 Minamidaira 2-chome, Mizuho-machi, Nishitama-gun, Tokyo 190-1224 (JP).  
**KIMURA, Satoshi** [JP/JP]; 338-4 Hatanaka, 1-chome, Ome-shi, Tokyo 198-0061 (JP).

(74) Agent: **KIMURA, Mitsuru**; 9540 Patent Attorney, 2nd Floor, Kyohan Building, 7 Kandanishiki-cho, 2-chome, Chiyoda-ku, Tokyo 101-0054 (JP).

(81) Designated States (national): AE, AU, CA, CN, ID, IN, KR, MX, NO, NZ, PH, RU, SG, US, VN.

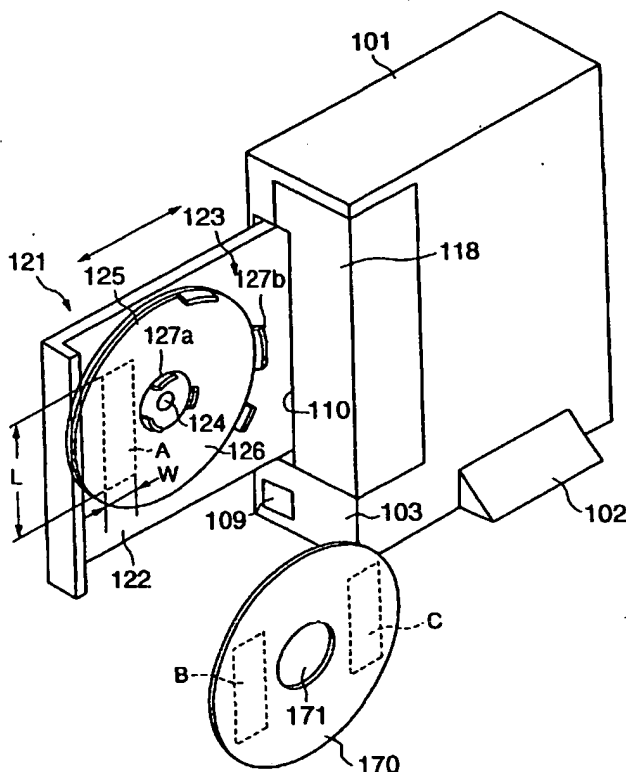
(84) Designated States (regional): European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR).

**Published:**

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

[Continued on next page]

(54) Title: **PRINTING APPARATUS, PRINTING METHOD, AND PROGRAM**



(57) Abstract: In a case (101) with the shorter side at the top, a tray (121) is placed substantially vertically, an optical disk (170) is substantially vertically supported on the tray (121), and a printer section (135) is provided to be opposite to the tray (121). In the printer section (135), a carriage (141) equipped with a thermal head (142) is structured to be movable vertically along the tray (121). When the carriage (141) moved vertically downward, the thermal head (142) is driven to provide thermal transfer printing of a title and the like, which indicate the contents of data recorded on the optical disk (170), to the surface thereof through an ink ribbon (162).

WO 03/091035 A1



---

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## DESCRIPTION

## PRINTING APPARATUS, PRINTING METHOD, AND PROGRAM

## 5 Technical Field

The present invention relates to a printing apparatus, printing method, and a program for printing information such as a title and the like of data recorded on a recording medium on the surface of the recording medium such as an optical disk and the like as a printing object.

## 10 Background Art

Conventionally, the applicant of this invention has proposed printing apparatuses that print a title of an optical disk such as CD-R (Compact Disk-Recordable) on its surface, and put them on the market in Japan.

This type of printing apparatus includes a tray that supports a disk and a printer  
15 mechanism that performs printing to the disk supported by the tray. The tray is moved to an external section of an apparatus main body by an eject operation. The printer mechanism performs thermal transfer printing to an optical disk, which is supported on the tray provided at a predetermined position in the apparatus main body and which is in a stationary state, using an ink ribbon by a thermal head that moves back and forth.

20 The aforementioned printing apparatus includes a flat box-shape apparatus main body. In the apparatus main body, there is provided the printer mechanism in which the tray, which supports the optical disk horizontally, is placed horizontally, and a carriage equipped with a thermal head is moved back and forth along on the tray.

In the conventional printing apparatus, since the tray is horizontally placed in the  
25 apparatus main body to support the optical disk horizontally, the apparatus main body becomes a flat box shape whose bottom area is larger than the height. For this reason,

when this apparatus is used as peripheral equipment of the computer system, there is a problem that the space for installment becomes large.

Moreover, in the aforementioned printer mechanism, printing is performed to the surface of the optical disk in one rectangular range, which corresponds to an effective print width that the thermal head has and a distance where the thermal head moves and scans, by one print operation.

Accordingly, in a case where a user desires to provide printing to a plurality of portions of the surface (label surface) of the optical disk by the printer mechanism, the user must carry out the following operations. Namely, the user once pushes the tray out of the printing apparatus by the eject operation after printing one portion. Then, in order that an area, which is opposite to a print area at the first print around a hole of the disk, is made correspond to the position of the printer mechanism, the user rotates the optical disk on the tray at 180° manually to be reset and turns the tray to the apparatus main body. Then, printing is performed to the different portion by a second print operation of the printer mechanism.

In other words, according to this type of printing apparatus, every time when one print processing ends, the tray must be ejected to the external section of the printing apparatus that can attach/detach the optical disk thereto/therefrom. Moreover, such a complicated task is needed that the positioning is performed on the tray to change the placement of optical disk manually and the tray is turned to the apparatus main body to restart the printing operation. For this reason, efficiency of printing work will be reduced.

#### Disclosure of Invention

An object of the present invention is to provide a printing apparatus with a small installment space and a printing method.

Another object of the present invention is to provide a printing apparatus whose consumption power at a print operating time is small and a printing method.

Further another object of the present invention is to provide a printing apparatus and a printing method capable of efficiently performing printing to a plurality of portions on the surface of a printing object with a simple apparatus configuration.

In order to attain the above object, a printing apparatus according to a first aspect of  
5 the present invention comprising support means for supporting a data recordable recording medium substantially vertically; and print means for printing predetermined data to the recording medium supported by the support means.

According to this configuration, since the recording medium is supported substantially vertically in the printing apparatus, it is possible to contain the support means and the print  
10 means in the box-shaped case with the small bottom area and the shorter side at the top, so that the installment area for the apparatus can be reduced.

In the above configuration, the print means may include a print head to move the print head substantially vertically along the recording medium supported by the support means, and to drive the print head to perform printing to a predetermined area of the recording  
15 medium.

In the above configuration, when the print means moves the print head substantially vertically from the upper to the lower, the print head may be driven.

According to this configuration, it is possible to use the weight of the print means (carriage) at the print operating time, and a load on the motor for driving the print means to  
20 be moved can be reduced. Accordingly, the motor can be miniaturized and the power consumption can be reduced.

Moreover, when the print means moves the print head substantially vertically from the lower to the upper, the print head may be driven.

In the above configuration, the print means may include a print head to move the print  
25 head substantially horizontally along the recording medium supported by the support means, and to drive the print head to perform printing to a predetermined area of the recording

medium.

Moreover, the print mean may further include a carriage that is equipped with the print head and that moves along the recording medium supported by the support means, and the print head may move in accordance with movement of the carriage, and provide thermal transfer printing of an image based on predetermined print data to a surface of the recording medium through an ink ribbon.

In the above configuration, the support means may further include rotation drive means, having a rotatable base for rotating the recording medium, for driving the rotatable base to be rotated; print means for performing printing to the recording medium supported by the support means; and control means for controlling the operations of the rotation drive means and the print means. The control means may selectively operate the rotation drive means and the print means.

According to this configuration, the apparatus can be configured simply and at low cost. Further, it is possible to provide a printing apparatus capable of efficiently performing printing to a plurality of portions on the surface of a printing object with a simple operation in a state that the printing object is mounted on the rotatable base.

Moreover, since the rotation drive means and the print means are selectively operated, the driving power supply source of the printing apparatus can be manufactured at low cost by configuring it in a small scale.

In the above configuration, the control means may include a print head that moves as pressing against the recording medium supported by the support means through an ink ribbon to perform thermal transfer printing. The support means is movable to a position where the recording medium is attached/detached to/from the rotatable base and a position where printing is performed to the recording medium, which is supported by the rotatable base, by the print means. The rotatable base may include a cushion member, which abuts against the recording medium, and engaging means, which engages with the recording

medium, on a surface where the recording medium is mounted.

According to this configuration, since the cushion member is provided on the surface of the rotatable base where the printing object is mounted, when the print head presses against the printing object, the cushion member equally elastically deforms, so that the print head comes in contact with the surface of the printing object equally. Accordingly, satisfactory printing can be performed. Furthermore, since the rotatable base includes engaging means for engaging the printing object, it is possible to prevent the printing object from being detached even if the printing object is engaged with the rotatable base without fail and, for example, the printing apparatus is used in a vertical position.

10 In the above configuration, the cushion member may be provided at a position on the rotatable base subjected to pressure by the print head at the time of printing to the recording medium in a range corresponding to a width of the print head and a length where the print head presses against the recording medium and moves.

According to this configuration, the cushion member is provided at the position on the 15 rotatable base subjected to pressure by the print head at the time of printing to the recording medium in the range corresponding to the width of the print head and the length where the print head presses against the recording medium and moves. Accordingly, when the print head presses against the printing object, the cushion member equally elastically deforms, so that the print head comes in contact with the surface of the printing object equally, so that 20 satisfactory printing can be performed.

The print means may include a print head that moves as pressing against the recording medium supported by the support means through an ink ribbon to perform thermal transfer printing. The support means may include a support base, which supports the rotatable base to be rotatable around a rotation shaft and to be rotatable in an axial direction of the rotation 25 shaft, and urging means for urging the rotatable base to the support base. One of opposing surfaces of the support base and the rotatable base may include convex portions, which

project from the one opposing surface and which slide in contact with the other opposing surface opposing to the one opposing surface during the rotating operation of the rotatable base by the rotation drive means, around the rotation shaft. The other opposing surface may include concave portions, into which the convex portions are fit at the print operating  
5 time by the print means, around the rotation shaft.

According to this configuration, when the rotational base rotates at a non-print operating time, the rotatable base contacts the convex portions and rotates smoothly, and the convex portions fit into the concave portions by urging means at the printing time, thereby the rotatable base is stably supported at the position with a predetermined rotation angle.

10 At least one of opposing surfaces of the support base and the rotatable base may include a member having a thickness smaller than a projection height of the convex portion, a cushion property, and a friction property.

According to this configuration, when the convex portions fit into the concave portions, the rotatable base is adhered to the support base through the member having the cushion  
15 property and the friction property, and the rotatable base is thereby stably supported at the position with the predetermined rotation angle.

The print means may include a print head that moves as pressing against the recording medium supported by the support means through an ink ribbon to perform thermal transfer printing. The support means supports the rotatable base rotatably, and is movable to a  
20 position where the recording medium is attached/detached to/from the rotatable base and a position where printing is performed to the recording medium, which is supported by the rotatable base, by the print means. Either one of opposing surfaces of the support base and the rotatable base opposing to each other may include convex portions, which project from the one opposing surface and which abut against other opposing surface opposing to the one  
25 opposing surface, at a portion subjected to pressure by the print head.

According to this configuration, since either one of opposing surfaces of the support



base and the rotatable base opposing to each other may include convex portions, which project from the one opposing surface and which abut against other opposing surface opposing to the one opposing surface, at a portion subjected to pressure by the print head, the rotatable base can receive the pressure of the print head stably and equally.

- 5        A rotating direction of the rotatable base driven to be rotated by the rotation drive means and a moving direction of the print head may be opposite to each other in the direction at a print portion.

According to this configuration, since the rotating direction of the rotatable base driven to be rotated by the rotation drive means and the moving direction of the print head  
10 may be opposite to each other in the direction at a print portion, no backlash occurs in the rotation drive means for driving the rotatable base to be rotated. Accordingly, the rotational base is prevented from being slightly rotated at the print operating time, so that satisfactory printing can be performed.

The rotation drive means may include a drive motor and a gear train having a worm  
15 gear that transmits power of the drive motor to the rotatable base.

According to this configuration, the rotation drive means includes the drive motor and the gear train having the worm gear that transmits power of the drive motor to the rotatable base, and this eliminates the accidental rotation of the rotatable base at the print head moving time. Accordingly, the rotatable base is maintained in a fixed state without fail, so  
20 that satisfactory printing can be performed.

In the above configuration, the printing apparatus may further comprise detecting means for detecting kinds of predetermined print objects supported by the support means. The support means may support a first print object and a second print object selectively. The control means may selectively operate the rotation drive means and the print means  
25 when the detecting means detects the first print object, and may stop operating the rotation drive means and operate only the print means when the detecting means detects the second

print object.

In the above configuration, the first print object may be a disk-like data-recordable recording medium having a predetermined diameter, and the second print object may be a rectangular paper material whose one side has substantially a same length as the  
5 predetermined diameter.

In order to attain the above object, a printing method according to a second aspect of the present invention comprises the steps of supporting a data recordable recording medium substantially vertically in a printing apparatus; and printing predetermined data to the recording medium supported in the supporting step.

10 In the above method, the printing step may include the steps of moving a print head substantially vertically along the recording medium supported in the supporting step; and driving the print head moved in the moving step to perform printing to a predetermined area of a surface of the recording medium.

In the above method, the printing step may include the steps of moving a print head  
15 substantially horizontally along the recording medium supported in the supporting step; and driving the print head moved in the moving step to perform printing to a predetermined area of a surface of the recording medium.

In the above method, in the printing step, a carriage that is equipped with the print head may be moved along the recording medium to move the print head to a predetermined  
20 position, and thermal transfer printing of an image based on print data may be provided to a surface of the recording medium through an ink ribbon.

In the above method, the method may further comprise the step of rotating the recording medium up to a predetermined angle in the print apparatus. The rotating step and the printing step may be selectively executed to perform printing to a plurality of  
25 portions on the surface of the recording medium.

In order to attain the above object, a program according to a third aspect of the present

invention controls a computer to execute: a step of storing predetermined print data; a step of supporting a data recordable recording medium substantially vertically in a printing apparatus; a step of moving a print head along the recording medium supported substantially vertically, in a substantially vertical direction or in a substantially horizontal direction; and a  
5 step of printing the print data to a predetermined area on a surface of the recording medium by driving the print head moved in the moving step.

#### Brief Description of Drawings

Embodiments of the present invention will be explained as follows with reference to the following drawings.

10 FIG. 1 is a perspective view showing a state that a printing apparatus according to a first embodiment of the present invention is used;

FIG. 2 is an exploded perspective view showing an internal mechanism of the printing apparatus of FIG. 1;

FIG. 3 is a plane structural view at the time of ejecting a support tray of the printing  
15 apparatus of FIG. 1;

FIG. 4 is a plane structural view at the time of inserting a support tray of the printing apparatus of FIG. 1;

FIG. 5 is a plane structural view showing the principal part of a moving mechanism for a support tray in the printing apparatus of FIG. 1;

20 FIGS. 6A and 6B are cross-sectional views each showing a support tray and a rotatable base in the printing apparatus of FIG. 1;

FIG. 7 is a structural view showing a tray moving position detection switch in the printing apparatus of FIG. 1;

FIGS. 8A and 8B are structural views each showing a kind detection switch that  
25 detects a kind of a printing object in the printing apparatus of FIG. 1;

FIG. 9 is a perspective view showing an optical disk as a printing object and a paper

material;

FIG. 10 is a block diagram showing the structure of an electronic circuit of the printing apparatus of FIG. 1;

FIGS. 11A and 11B are explanatory views each showing a relationship in the position  
5 between a thermal head for printing and a cushion sheet on the rotational sheet in the printing apparatus of FIG. 1;

FIG. 12 is a plane structural view at the time of ejecting the support tray when printing is performed to the paper material;

FIG. 13 is a plane structural view at the time of inserting the support tray when  
10 printing is performed to the paper material;

FIG. 14 is a flowchart showing print processing of the printing apparatus according to the first embodiment of the present invention;

FIG. 15 is a cross-sectional view showing a modification of the support tray and rotatable plate in the printing apparatus of FIG. 1;

15 FIGS. 16A and 16B are views each showing the structure of a printer mechanism of the printing apparatus according to the first embodiment of the present invention;

FIG. 17 is a flowchart showing print processing of a printing apparatus according to a second embodiment of the present invention;

FIG. 18 is a perspective view showing the entirety of a printing apparatus according to  
20 a third embodiment of the present invention;

FIG. 19 is a side view showing the structure of the main parts of the printing apparatus of FIG. 18;

FIG. 20 is a front view showing the structure of the main parts of the printing apparatus of FIG. 18;

25 FIGS. 21A and 21B are views each showing the structure of a printer section of the printing apparatus according to the third embodiment of the present invention;

FIG. 22 is a view explaining force acting on the carriage of the printing apparatus of FIG. 1;

FIG. 23 is a side view showing the structure of the main parts of a printing apparatus according to a fourth embodiment of the present invention; and

5     FIG. 24 is a side view showing the structure of the main parts of a printing apparatus according to a fifth embodiment of the present invention.

#### Best Mode for Carrying Out the Invention

##### (First embodiment)

FIG. 1 is a perspective view of the entirety of a printing apparatus according to a first  
10     embodiment; FIG. 2 is an exploded perspective view of the main parts of the printing apparatus, and FIGS. 3 and 4 are views each showing a plane structural view of the main parts.

Additionally, the printing apparatus according to this embodiment can be used both horizontally and vertically. FIGS. 3 and 4 are plane views when the printing apparatus is  
15     placed horizontally. When the printing apparatus is placed vertically as shown in FIG. 1, a right side surface or a left side surface of a case 1 corresponds to a bottom surface in FIGS. 3 and 4.

The printing apparatus of this embodiment includes a tray mechanism that supports an optical disk and a printer mechanism that performs printing (label printing) to a surface  
20     (label surface) of the optical disk supported by the tray mechanism. This printing apparatus further includes an eject function of ejecting the tray mechanism to the external section of the apparatus main body, a rotation function of rotating the optical disk supported by the tray mechanism, and a thermal transfer print function of performing printing to the label surface of the optical disk using an ink ribbon.

25     An explanation will be first given of the structure of the main body of the printing apparatus and the structure of the tray mechanism.

This printing apparatus includes a rectangular box-shape case 1 and an opening 1a is formed on a front surface of this case 1. Then, an eject switch 2 is formed at a front surface of the case 1, and a base 3 shown in FIG. 2 is fixed to an interior of the case 1.

As shown in FIG. 2, a pair of guide rails 4, which extend in parallel to be spaced to 5 each other, is formed on an upper surface of the base 3, and a support tray 5 as a support base is slidably attached between these guide rails 4. The support tray 5 passes through the opening 1a, and slidably moves between the internal section of the case 1 and the external section thereof. Additionally, this support tray 5 is supported to have a fixed space between the base 3 and the support tray 5.

10 At one side portion of an upper surface of the base 3, there are provided a drive motor (DC motor) 6 for a tray and a gear train 7 composed of a plurality of first to fourth gears 7a to 7d driven by the drive motor 6. A pulley 7e is provided coaxially with the first gear 7a of the gear train 7, and the pulley 7e is coupled to a pulley 6a provided at an output shaft of the drive motor 6 through a belt 8. Moreover, the second gear 7b and the gear 7c mesh 15 with the first gear 7a and the third gear 7c, sequentially, so that rotational power of the drive motor 6 is transmitted to the third gear 7c.

The third gear 7c and fourth gear 7d are coupled to each other through a lug mechanism (intermittent gear mechanism). When the third gear 7c rotates by an angle of, for example, 135° in a forward direction, rotational power of the third gear 7c is transmitted 20 to the fourth gear 7d. Moreover, when the third gear 7c reversely rotates by an angle of 135° from this state, rotational power of the third gear 7c is transmitted to the fourth gear 7d.

A rack 11 is provided in the internal portion of the lower surface side of the support tray 5. Here, the lower surface side is the back surface side of the support tray 5, i.e., the 25 surface side opposite to the front surface to which the optical disk is mounted. The fourth gear 7d meshes with the rack 11. By this mesh, the support tray 5 moves in the back and

forth directions of the case 1 in accordance with the forward- reversal rotation of the fourth gear 7d to be displayed to an eject position (FIG. 3), which projects into the external section of the case 1, and a print position (FIG. 4), which is placed in the internal portion of the case 1.

5 In the case 1, there is provided a tray position detection switch 13 to be opposed to one side portion of the support tray 5. The detection switch 13 has a lever 13a. The lever 13a is engaged with a concave groove 14 formed on the side surface of the support tray 5 along its longitudinal direction. In accordance with the operation of the support tray 5 in the back and forth directions, the lever 13a is displaced to a neutral position N, an open position 10 O, and a close position C as shown in FIG. 7.

Moreover, in the case 1, there is provided an actuation gear 17 corresponding to the fourth gear 7d. The actuation gear 17 has a fan shape and rotates with a support shaft 18 as a fulcrum. A first half section of its periphery is a teeth portion 17a in which teeth are arranged and a second half section thereof is a tooth omitting portion 17b in which teeth are 15 omitted.

A small gear 9 is provided to the third gear 7c of the gear train 7 in a body, and the teeth portion 17a meshes with the small gear 9 in accordance with the rotation of the actuation gear 17.

A pin 19 is attached to a plate surface of the actuation gear 17 to be adjacent to the 20 tooth omitting portion 17b. On a lower surface of the support tray 5, there is formed a guide groove 20 that extends along the back and forth direction of the tray 5. The pin 19 is slidably fit into the guide groove 20. In accordance with the movement of the support tray 5 in the back and forth directions thereof, the pin 19 relatively moves along the guide groove 20.

25 At an end portion of the top end side of the guide groove 20, there is formed a circular path 21 having an outward path 21a and a backward path 21b. In accordance with the

backward movement of support tray 5, the pin 19 enters the backward path 21b from the guide groove 20.

At an inner portion of the back side of the case 1, there is provided a hook lever 24 that rotates with a support shaft 23 as a fulcrum. The hook lever 24 has a hook portion 25.

5 Moreover, an actuation rod 26 is provided between the end portion of the top end side of the hook lever 24 and one side surface of the actuation gear 17.

The actuation rod 26 is supported to be slidable along the back and forth directions of the case 1 through a plurality of guide pieces 27 provided to the base 3, and the end portion of one side surface of the actuation rod 26 abuts against one side surface of the actuation  
10 gear 17. Moreover, the hook lever 24 is elastically urged clockwise in the figure by a spring 28, and the hook lever 24 elastically abuts against the end portion of the other end side of the actuation rod 26 by this urging force. At a lower surface of the back side of the support tray 5, there is provided a hook receiver 29 which is engageable with the hook portion 25, to correspond to the hook portion 25.

15 On the upper surface of the support tray 5, a disk-like concave portion 31 is formed. The upper surface is the surface to which the optical disk is mounted. In the concave portion 31, a rotatable base 32 is formed, and the rotatable base 32 and support tray 5 forms support means for supporting a printing object.

The rotatable base 32 has a rotating shaft 33 in a body at the central portion of the  
20 lower surface as shown in FIG. 6. The rotating shaft 33 is rotatably inserted into a fitting hole 34 formed on the support tray 5. A gear 35 is attached to an end portion outer periphery on the inserting side to be unrotatable and slidable in an axial direction.

Moreover, a belleville-spring 36 is attached to the end portion of the rotating shaft 33 at the lower surface side of the gear 35. The periphery portion of the belleville-spring 36  
25 elastically abuts against the lower surface of the gear 35. Moreover, the rotatable base 32 is elastically urged to the downward support tray 5 by the belleville-spring 36.



On the lower surface of the rotatable base 32, a plurality of convex portions 38 is formed to be projected with equal intervals on a circumference around the rotating shaft 33. On the support tray 5, there is a plurality of transparent hole-like concave portions 39 corresponding to the respective convex portions 38. Namely, when the convex portions 38 5 and the concave portions 39 face each other, respectively, the convex portions 38 fall in the concave portions 39 to be engaged with each other, respectively.

A friction sheet 40, which is made of high cushioning and friction material such as rubber and has a low thickness, that is, lower than the projection height of the convex 38, is adhered to the lower surface of the rotatable base 31, which is the portion of the outside area 10 of the convex portion 38. At the central portion of the upper surface of the rotatable base 32, there is formed a plurality of elastically deformable projection pieces 41 to be equally positioned on the same circumference to be projected. The projection pieces 41 are used as engaging means for engaging a printing object and are arc-shaped seeing from the plane.

At the lower surface of the rotatable base 32, there are provided a gear 44 and a drive 15 motor 45 for a rotatable base. The gear 44 has a large gear 44a and a small gear 44b in a body. A worm gear 46 is attached to a rotating shaft 45a of the drive motor 45 (DC motor). The worm gear 46 meshes with the large gear 44a of the gear 44. Moreover, the small gear 44b of the gear 44 meshes with the gear 35, and the rotational power of the drive motor 45 is transmitted to the rotatable base 32 through the worm gear 46, gear 44, and gear 35. 20 Moreover, a disk 47 provided with a plurality of slits formed around its circumference is attached to the rotating shaft 45a. An encoder 48 having a light emitting element and a light receiving element which are arranged so as to sandwich this disk 47 is provided.

A rotation position detection switch 50 is provided at the outside of a part of the inner periphery of the concave portion 31 formed on the upper surface of the support tray 5. The 25 rotation position detection switch 50 has an actuator 50a that elastically projects. The actuator 50a elastically abuts against the outer peripheral surface of the rotatable base 32.

On the outer peripheral surface of the rotatable base 32, four concave portions 51 are formed at 90 degrees intervals. The concave 51 faces the actuator 50a according to the rotation of the rotatable base 32. The actuator 50a falls in the concave portion 51 at the facing position, so that the rotation position of the rotatable base 32 is detected.

5 A cushion sheet 61, which is formed of elastic material with excellent cushion and adherence, is adhered to the upper surface of the rotatable base 32 to serve as a placing surface for an optical disk 100a to correspond to the print position of the printer mechanism that is subjected to pressure from a thermal head 58 at a printing time. In this printing apparatus, after the end of one print operation by the printer mechanism, the rotation base  
10 rotates clockwise every 90° or 180° and stops, and printing is performed to the optical disk 100a at each stopped position. For this reason, the cushion sheet 61 is formed to be square-frame shaped in such a manner to surround the center of the rotatable base 32 in order to correspond to four print areas to be set on the optical disk 100a at the maximum. Then, when the rotatable base 32 rotates clockwise every 90° or 180° and stops, the respective  
15 sides, which form the square frame of the cushion sheet 61, are made to correspond to the print operation range (printable area) of the thermal head 58 of the printer mechanism. When the cushion sheet 61 is placed at the position corresponding to the print operation range of the thermal head 58 of the printer mechanism, the convex portion 38 formed on the lower surface of the rotatable base 32 is fit into the concave portion 39 formed on the  
20 support tray 35.

An explanation will be next given of the structure of the printer mechanism provided with the printing apparatus.

As shown in FIGS. 2 to 4, a gate-like frame 54 is attached onto the base 3 to be stretched over the support tray 5. A guide shaft 55 is constructed in the inner side of the  
25 frame 54, and a carriage 56 is movably attached to the guide shaft 55. At the front surface of the carriage 56, a head cover 57 is formed to be projected. At the lower surface of the

head cover 57, a thermal head 58 as a print head is provided. A ribbon cartridge 56, which contains an ink ribbon, is provided to be attachable/detachable to/from the front surface of the carriage 56. In the carriage 56, a running drive mechanism for the carriage 56, a head moving mechanism for the thermal head 58 and an ink ribbon winding mechanism and the like are provided. Moreover, a forward-reverse rotational drive motor for the carriage (stepping motor) 60 as a drive source for each mechanism is attached to the back surface of the carriage 60.

An explanation will be further given of the structure of the printer mechanism based on FIGS. 16.

10 A ribbon cartridge 59, which contains an ink ribbon 80 as a consumable material, is provided to be attachable/detachable to/from the cartridge attaching surface of the front surface of the cartridge 56. The ribbon cartridge 59 includes a case 81. On the case 81, there is formed a concave portion 82 into which the head cover 57 is fit.

In the case 81, a ribbon supply core 83 and a ribbon winding core 84 are provided and 15 the ink ribbon 80 is wound around the ribbon supply core 83 in the form of roll. The ink ribbon 80 paid out from the ribbon supply core 83 is hooked on the winding core 84 through a plurality of guide pins 85. The ink ribbon 80 is sequentially wound around the winding core 84 in accordance with the forward rotation of the winding core 84. The middle of the ink ribbon 80 is exposed to the external section of the case 81 and runs along the lower 20 surface side of the concave portion 82 where the thermal head 58 is positioned.

In the carriage 56, there is provided an output gear 86 attached to an output shaft of the drive motor 60 for a carriage, and a first gear 87a meshes with the output gear 86.

Moreover, a second gear 87b is provided coaxially with the first gear 87b. A third gear 87c meshes with the second gear 87b, and a fourth gear 87d meshes with the third gear 87c.

25 Then, a ribbon winding shaft 88 is provided coaxially with a rotating shaft of the fourth gear 87d through a one-way clutch (not shown). The ribbon winding shaft 88

projects forward from the cartridge attaching surface of the carriage 56 to engage with the winding core 84 according to the attachment of ribbon cartridge 59 to the cartridge attaching surface.

The third gear 87c meshes with the rack (not shown) provided to the frame 54 along a running path of the carriage 56 in parallel with the guide shaft 55. By this mesh, the carriage 56 reciprocates along the guide shaft 55 in accordance with the forward-reversal rotation of the third gear 87c.

Moreover, a cam gear 89 is provided in the carriage 56. The cam gear 89 is provided with a gear at its circumference, and an arc-shape cam groove 90, which is off-centered against the center of the rotation is formed in the side surface of the gear. Then, a swing clutch 91 is formed between the cam gear 89 and the output gear 86. The swing clutch 91 is composed of a sun gear 92, which meshes with the output gear 86, and a pair of planet gears 94a and 94b, which mesh with the sun gear 92 and which are supported to be movable in the circumferential direction of the sun gear 92 through an arm 93. At the forward rotating time of the sun gear 92 (at the rotation time clockwise), one planet gear 94a meshes with the cam gear 89 and the other planet gear 94b separates from the cam gear 89.

Meanwhile, at the reverse rotating time of the sun gear 92 (at the rotation time anticlockwise), one planet gear 94a separates from the cam gear 89 and the other planet gear 94b meshes with the cam gear 89.

In the carriage 56, there is provided a head arm 96 that rotates up and down around the center of a shaft 95. The head arm 96 is elastically urged anticlockwise in FIG. 16 by a spring 97 provided at the end portion of the one end side in a tensioned state. Further, the head arm 96 is provided with a pin 98 close to the one end portion. The pin 98 is slidably inserted to the cam groove 90 of the cam gear 89. A head holder 99 is attached to the end portion of the other end side of the head arm 96. The head holder 99 is placed in the head cover 57, which projects to the front side of the carriage 56, and extends to the front side of

the carriage 56 along the head cover 57. Moreover, a head base 101 is supported at the lower surface of the head holder 99 through a shaft 100. The thermal head 58 as the print head is attached to the lower surface of the head base 101. The thermal head 58 is placed to be opposed to the opening of the lower surface of the head cover 57.

5       The thermal head 58 is pressed via the ink ribbon paid out from the ribbon cartridge 59, onto the label surface which is opposite to the signal recording surface of the optical disk 100a which is held standstill on the stopped rotatable base 32. In this state, the thermal head 58 moves from left to right in FIG. 2 along the guide shaft 56 together with the carriage 59. During this movement, printing is performed by the thermal transfer method  
10 in which a predetermined image is thermally transferred to the surface of the optical disk 100a as melting ink of the ink ribbon. Accordingly, a rectangular area, which is fixed by the width of the row of the heat elements for the thermal head 58 (width in the main scanning direction) and the moving distance of the thermal head 58 (length in the sub-scanning direction) perpendicular to the width of the row, becomes a print range obtained by  
15 one print operation.

An explanation will be next given of the operation of each component of the printing apparatus.

First, an explanation will be given of an operation in which the support tray 5 moves to the internal and external sections of the case 1. As a preparation before printing, the tray  
20 mechanism is ejected to the outside of the apparatus by the ejection operation and the optical disk 100a is mounted on the tray and the tray is returned to the printing apparatus, and set to the print position.

At a print starting time, as shown in FIG. 4, the support tray 5 is inserted into the case 1, and the hook receiver 29 is engaged with the hook portion 25 of the hook lever 24. The  
25 teeth portion 17a of the actuation gear 17 meshes with the small gear of the fourth gear 7d of the gear train 7. At this time, the pin 19 of the actuation gear 17 is positioned at the end

top portion of the circular path 21 which coincides with the end portion of the guide groove 20 formed in the lower surface of the support tray 5, and the lever 13a of the tray position detection switch 13 is placed at the close position C.

From this state, the eject switch 2 at the front of the case 1 is operated. The drive motor 6 for tray starts in accordance with this operation, the rotational power is transmitted to the gear train 7 through the belt 8, and the third gear 7c rotates clockwise in FIG. 4. At this time, since the third gear 7c and fourth gear 7d are coupled to the lug mechanism, only the third gear 7c rotates and the fourth gear 7d does not rotate, so that the stop state of the support tray 5 is maintained.

10 When the third gear 7c rotates clockwise, the actuation gear 17, which has been meshed with the small gear 9 of the third gear 7c, rotates anticlockwise. At this time, the pin 19 of the actuation gear 17 moves to the guide groove 20 through the backward path 21b of the circular path 21.

When the actuation gear 17 rotates anticlockwise, the hook lever 24 rotates anticlockwise against the spring 28 through the actuation rod 26 by the actuation gear 17. By this rotation, the hook portion 25 is detached from the hook receiver 29 and the engagement of the support tray 5 is released. When the actuation gear 17 rotates to a fixed angle, the teeth portion 17a of the actuation 17 is detached from the small gear 9 and the actuation gear 17 stops at this position.

20 After that, when the rotational power of the third gear 7c is transmitted to the fourth gear 7d and the fourth gear 7d rotates clockwise together with the third gear 7c. By this rotation, the support tray 5 moves toward the front of the case 1. At this time, the pin 19 of the actuation gear 17 relatively moves along the guide groove 20 of the support tray 5.

When the support tray 5 starts to move, the front portion side end wall of the concave groove 14 of the support tray 5 separates from the lever 13a of the tray position detection switch 13 and the lever 13a moves to the neutral position N from the close position C

accordingly. Then, when the support tray 5 moves forward and projects to a predetermined length from the case 1, the back side end wall of the concave groove 14 abuts against the lever 13a of the tray position detection switch 13 and the lever 13a moves to the open position O from the neutral position N accordingly. Based on the switch signal at this time, the drive motor 6 for tray is controlled to be stopped and the support tray 5 thereby stops at a predetermined eject position.

Here, the user mounts the optical disk 100a on the rotatable base 32 of the support tray 5 and fits the disk hole at the center of the optical disk 100a into the projection piece 41 elastically, so that the optical disk 100a is fixed to the rotation base 32.

10 Next, in the case where the support tray 5 is moved into the apparatus, the user slightly presses the support tray 5 manually. By the pressing operation, the back side end wall of the concave groove 14 separates from the lever 13a of the tray position detection switch 13 and the lever 13a moves to the neutral position N from the open position O accordingly. Based on the switch signal at this time, the drive motor 6 for tray is driven and reversely rotated. Additionally, even when the operation is performed by the eject switch 2 in place of pressing the support tray 5 manually, the same operation is performed.

The reverse rotational power of the drive motor 6 for tray is transmitted to the gear train 7 through the belt 8, and the third gear 7c rotates anticlockwise in FIG. 3. Since the third gear 7c is coupled to the fourth gear 7d by the lug mechanism, the rotational power of the third gear 7c is not initially transmitted to the fourth gear 7d. However, after the third gear 7c rotates to a fixed angle, the power of the third gear 7c is transmitted to the fourth gear 7d and the fourth gear 7d rotates anticlockwise together with the third gear 7c. Moreover, since the teeth portion 17a separates from the small gear 9 of the third gear 7c, the stop state of the actuation gear 17 is maintained regardless of the rotation of the third gear 7c. When it rotates in the anticlockwise direction of the fourth gear 7d, the support tray 5 is drawn into the case 1 accordingly. At this time, the pin 19 of the actuation gear 17

relatively moves along the guide groove 20 of the support tray 5.

When the support tray 5 is drawn into a predetermined position of the case 1, that is, a print position, the front side end wall of the concave groove 14 abuts against the lever 13a of the tray position detection switch 13 and the lever 13a moves to the close position C from the neutral position N accordingly. Based on the switch signal at this time, the drive motor 6 for tray is controlled to be stopped and the support tray 5 thereby stops at a predetermined print position. Just before the support tray 5 reaches the print position, the pin of the actuation gear 17 reaches a point A of the guide groove 20 in FIG. 5, and further moves to a point B through the outward path 21a of the circular path 21 from the point A. Then, in accordance with movement of the pin 19, the actuation gear 17 rotates clockwise and the teeth portion 17a meshes with the small gear 9 of the third gear 7c. By this mesh, the actuation gear 17 further rotates anticlockwise, and the pin 19 reaches a point C of the end top portion of the circular path 21.

When the actuation gear 17 rotates clockwise, pressure to the actuation rod 26 is released. By this release, the actuation rod 26 is moved to the forward side of the case 1, and the hook lever 24 is rotated clockwise by the urging force of the spring 28. The hook portion 25 is placed at an engage standby position to the hook receiver 29. Thereafter, the support tray 5 moves to the print position and stops. Just before the stop, the hook lever 24 is engaged with the hook portion 25 of the hook lever 24. By this engagement, the support tray 5 is stably positioned at a predetermined print position.

Thus, in the standby state during the start of printing, the support tray 5 is ejected to the outside of the case 1 by the eject operation, and the rotatable base 32 is placed at a predetermined stop position on the support tray 5 at the time of returning to the case 1. Namely, one side of the square of the cushion sheet 61 formed on the upper surface of the rotatable base 32 is positioned to be opposed to the print operation range (printable range) of the thermal head 58. Moreover, the respective convex portions 38 of the lower surface of



the rotatable base 32 are fit into the respective concave portions 39 of the upper surface of the support tray 5, so that the lower surface of the rotatable base 32 abuts against the upper surface of the support tray 5.

Moreover, according to this printing apparatus, when printing to one portion on the optical disk 100a is ended by one print operation of the printer mechanism, the rotation base 32 is rotated to a next stop position by a predetermined angle in order that printing should be performed to the next print portion on the optical disk 100a in the state that the operation of the printer mechanism is stopped. The following will explain the operation of the rotation mechanism.

10 As explained above, on the upper surface of the support tray 5, the cushion sheet 61 is formed to be square-frame shaped, and the position where each size of the square corresponds to the print operation range of the thermal head 58 becomes a stop possible position, and one to four print areas at the maximum on the optical disk 100a can be arbitrarily set.

15 When the drive motor 45 for a rotatable base is driven, the rotational power due to this drive is transmitted to the rotatable base 32 through the worm gear 46, the large gear 44a of the gear 44, the small gear 44b of the gear 44, and the gear 35, and the rotatable base 32 rotates clockwise. When the rotatable base 32 rotates, the respective convex portions 38 of the lower surface of the rotatable base 32 slide on the upper surface of the support tray 5,  
20 and the friction is thereby reduced and the rotatable base 32 rotates smoothly.

In the case where printing is performed to two portions on the optical disk 100a, the rotatable base 32 is rotated 180° after the first printing, so that the second printing is performed. Meanwhile, in the case where printing is performed to four portions on the optical disk 100a, the rotatable base 32 is rotated 90° after the first printing, so that the  
25 second printing is performed. Then, the rotatable base 32 is rotated every 90° in a like manner, so that the third and fourth printing is performed.

A predetermined rotation angle at which the rotatable base 32 should be rotated is detected by the rotation position detection switch 50 and an output signal from the encoder 48. For example, in the case where a predetermined rotation angle is  $90^\circ$ , this angle is detected with reference to the point that the number of output pulses from the encoder 48 reaches a predetermined number after the rotation position detection switch 50 detects the concave portion 51. In the case where a predetermined rotation angle is  $180^\circ$ , this angle is detected with reference to the point that the number of output pulses from the encoder 48 reaches a predetermined number after the rotation position detection switch 50 detects the second concave portion 51. When the predetermined rotation angle is detected, the drive of the drive motor 45 for a rotatable base is stopped, so that the rotatable base 32 stops.

When the rotation of the rotatable base 32 is stopped, the cushion sheet 61 is always provided at the position corresponding to the print operation area of the thermal head 58.

When the rotatable base 32 rotates to the predetermined angle and the cushion sheet 61 is provided at the position corresponding to the print operation area of the thermal head 58, the respective convex portions 38 fall in the respective concave portions 39 of the support tray 5 and fit thereto by the urging force of belleville-spring 36 as shown in FIG. 6B. In other words, the rotatable base 32 is moved downward. By this movement, the rotatable base 32 is adhered to the support tray 5 through the friction sheet 40, so that the rotatable base 32 is stably supported at the position with a predetermined rotation angle.

According to the above-structured printing apparatus, on the upper surface of the rotatable base 32 that supports the optical disk 100a, the cushion sheet 61 is adhered to the area corresponding to the moving area of the thermal head 38 at the print operation time. The cushion sheet 61 has the size corresponding to the width of the heat element row of the thermal head 58 and the length of the movement thereof. For this reason, when the thermal head 58 presses against the surface of the optical disk 100a, the cushion sheet 61 is equally elastically deformed in the direction of the heat element row of the thermal head 58,

so that the heat element row of the thermal head 58 comes in contact with the surface of the optical disk 100a uniformly as shown in FIG. 11A. As a result, satisfactory printing can be performed.

In the case where the cushion sheet 61 is adhered to the entire area of the upper surface 5 of the support tray 5 as shown in FIG. 11B, the cushion sheet 61 is not equally elastically deformed because the optical disk 100a made of plastic plate material is bent as shown in FIG. 11B by the pressure of the thermal head 58. For this reason, there occurs imbalance that pressing force at the central portion is insufficient as compared with pressing force at both end portions of the heat element row of the thermal head 58, exerting an unfavorable 10 influence upon printing.

However, according to this embodiment, since the cushion sheet 61 has the size corresponding to the moving range of the thermal head 58, pressing force becomes equal as each portion, so that satisfactory printing can be performed.

Moreover, as shown in FIG. 6B, the respective convex portions 38 of the rotatable 15 base 32 are fit into the respective concave portions of the support tray 5, and the lower surface of the rotatable base 32 is adhered to the upper surface of the support tray 5 through the friction sheet 40. The rotatable base 32 is structured such that the convex portions 38 formed on the lower surface to reduce a resistance load at the time of rotating operation slide on the upper surface of the support tray 5. However, at the predetermined rotation 20 stop position of the rotatable base 32, a space formed between the upper surface of the support tray 5 and the lower surface of the rotatable base 32 is eliminated, so that the optical disk 100a is stably supported against the pressing from the thermal head 58. Moreover, this prevents accidental rotation of the rotatable base 32 when the thermal head 58 moves.

Furthermore, when the rotatable base 32 is driven to be rotated by the drive motor 45 25 for a rotatable base, the power is transmitted to the rotatable base 32 through the gear train including the worm gear 46, that is, the worm gear 46, the large gear 44a of the gear 44, the

small gear 44b of the gear 44, and the gear 35, so that the rotatable base 32 rotates clockwise as shown by an arrow in FIG. 3. Though this will be described later, the rotational operation of the rotatable base 32 and the moving operation of the thermal head 58 are performed not simultaneously but alternatively. The thermal head 58 performs printing as moving from the home position, which is the left end side of the frame 54 shown in FIGS. 2 to 4, to the right direction at the time of the print operation. In this way, at the printing portion on the rotatable base 32, which is positioned at the front side of the support tray 5, where the thermal head 58 moves to perform printing, such a relationship is established that the rotational directional of the rotatable base 32 and the moving direction of the thermal head 58 at the print operation time are opposite to each other.

When the thermal head 58 and the rotatable base 32 are alternatively driven, at the printing portion of the rotatable base 3, for example, the thermal head 58 moves from the left to the right at the print operation time 2. On the contrary to this, when the rotational direction of the rotatable base 32 and the moving direction of the thermal head 58 at the print operation time are the same as in the case that the rotation of the rotatable base 32 is anticlockwise, there is a fear that the rotatable base 32 will rotate slightly at the time when the thermal head 58 is started to move by backlash caused by play of mesh of the teeth in the gear train. However, according to this embodiment, since the rotational directional of the rotatable base 32 and the moving direction of the thermal head 58 at the print operation time are opposite to each other, no backlash occurs and slight rotation of the rotatable base 32 can be prevented, so that satisfactory printing can be performed.

As further explanation is given, friction between the thermal head 58 and the back surface of the ink ribbon is extremely small. While, large friction is generated between a surface, which is opposite to the back surface of the ink ribbon, where ink is coated and the surface of the optical disk 100a where the ink-coated surface abuts. Since the friction between the thermal head 58 and the back surface of the ink ribbon is extremely small and

sliding occurs therebetween, no force is applied onto the optical disk 100a in accordance with the movement of the thermal head 58 even if the thermal head 58 moves on the optical disk 100a. However, when slight friction is generated between the thermal head 58 and the back surface of the ink ribbon for some reason, this becomes power that allows the optical disk 100a to be moved in the direction corresponding to the moving direction of the thermal head 58 and acts on the support tray 5 through the optical disk 100a, so that rotation is performed by the amount corresponding to the backlash of the gears which form the rotation drive mechanism of the support tray 5. For this reason, according to this embodiment, the support tray 5 is stopped during the print operation and printing is performed in a state that the optical disk 100a as the printing object to be mounted stands still, and this prevents the printing object from moving during the print operation and an unfavorable influence from being exerted upon the printing result.

Moreover, the gear train includes the worm gear 46 having a merit that it has efficient control over a force applied from the side of the load opposite to the side of the drive source. This eliminates the accidental rotation of the rotatable base 32 and the rotatable base 32 is maintained in a fixed state without fail, so that satisfactory printing can be performed.

An explanation will be next given of the operation of the printer mechanism.

In the printer mechanism at a print standby time, the head arm 96 on the carriage 56 is held substantially horizontally and the thermal head 58 is placed at a print standby position spaced from the surface of the optical disk 100a by a fixed distance. Moreover, the carriage 56 stops at the home position set in the vicinity of the left end portion of the moving range.

Next, when printing is started, the drive motor 60 for a carriage is driven forward and the output gear 86 rotates anticlockwise. The rotational power of the output gear 86 is transmitted to the first, second, third and fourth gears 87a, 87b, 87c, and 87d. Then, the third gear 87c, which meshes with the rack, rotates anticlockwise and thereby the carriage

56 is moved along the guide shaft 55 in the right direction. Moreover, the fourth gear 87d rotates and thereby the ribbon winding shaft 88 rotates in the ribbon winding direction together with the fourth gear 87d. Accordingly, the winding core 84 in the ribbon cartridge 59, which engages with the ribbon winding shaft 88, rotates and thereby the ink ribbon 80 is sequentially wound and runs.

In parallel with this operation, the sun gear 92 of the swing clutch 91 is driven to be rotated by the rotation of the output gear 86. In accordance with the rotation of the sun gear 92, one planet gear 94a comes close to the cam gear 89 to mesh with the cam gear 89. By this mesh, the rotational power of the sun gear 92 is transmitted to the cam gear 89, so that the cam gear 89 rotates clockwise.

The cam gear 89 rotates clockwise in the forward direction and thereby the pin 98 in the cam groove 90 moves upward together with the head arm 96. The head arm 96, which moves with the pin 96, rotates anticlockwise around the shaft 95. By this rotation, the thermal head 58 moves downward and inclines with respect to the horizontal direction as shown in FIG. 16B.

The tooth omitting portion (not shown) is formed on a part of the periphery of the cam gear 89. When the cam gear 89 rotates by a fixed angle, the planet gear 94a falls in the omitting portion and runs idle. As a result, the thermal head 58 is held at the print position, which maintains a predetermined inclination angle and which contacts the surface of the optical disk 100a to sandwich the ink ribbon 80 therebetween. In this case, the thermal head 58 comes in contact with the surface of the optical disk 100a at a predetermined pressure by elastic force due to the spring 97. When the motor 60 is further driven forward, since the planet gear 94a is positioned in the tooth omitting portion, the ink ribbon 80 is driven to be wound while the carriage 56 is moved in the right direction in a state that the thermal head 58 is maintained at the print position.

Then, at the same time with the movement of carriage 56 and the winding of ink

ribbon 80, the heating material of thermal head 58 is driven to be heated based on print data and ink of the ribbon 80 is sequentially melted, thermally transferred on the surface of the optical disk 100a, so that a character such as predetermined letter, mark, and the like is printed on a predetermined print area corresponding to the moving range of the carriage 56 (thermal head 58).

When the thermal head 59 ends the printing, the motor 60 is driven reservedly and the output gear 86 rotates in a reverse direction (clockwise). By the reverse rotation of the output gear 86, the third gear 87c also rotates reversely clockwise. In accordance with the reverse rotation of the third gear 87c, the carriage 56 moves in the reverse direction (left direction) along the guide shaft 55, and returns to the home position.

At this point, since the fourth gear 87d is coupled to the ribbon winding shaft 88 through the one-way clutch, the reverse rotating operation of the fourth gear 87d is not transmitted to the ribbon winding shaft 88 and the ribbon 80 is not wound.

At the same time, by the reverse rotation of the output gear 86, the sun gear 92 of the swing clutch 91 rotates reversely. By the reverse rotation of the sun gear 92, one planet gear 94 separates from the cam gear 89 and other planet gear 94b comes close to the cam gear 89, and meshes therewith. By this mesh, the rotational power of the sun gear 92 is transmitted to the cam gear 89, and the cam gear 89 rotates reversely anticlockwise.

Then, by the reverse rotation of the cam gear 89, the pin 98 in the cam groove 90 moves downward together with the head arm 96. Then, the head arm 96 rotates around the shaft 95 clockwise. By this rotation, the thermal head 58 moves upward and separates from the surface of the optical disk 100a, and the head arm 96 returns to the initial horizontal state. In addition, the tooth omitting portion (not shown) is formed on a part of the periphery of the cam gear 89. When the cam gear 89 rotates by a fixed angle and the thermal head 58 returns to the print standby position, the planet gear 94b falls in the omitting portion and runs idle. After the planet gear 94b falls in the omitting portion, only

the carriage 56 moves in the reverse direction (left direction) by the rotation of the motor 60 in a state that the thermal head 58 is maintained at the print standby position.

FIG. 10 shows the structure of an electrical circuit of the printing apparatus according to this embodiment. The printing apparatus includes a control section 80. A personal computer 68 is connected to the control section 70 by a USB cable 67 via an interface (I/F) 71.

The control section 70 includes a ROM 72 and a RAM 73. In the ROM 72, program data such as a system program that controls the operation of each component of the printing apparatus in accordance with a print control signal from the personal computer 68 is stored. Moreover, in the RAM 73, a memory that stores print data transmitted from the personal computer is included.

Further, the ink jet switch 2, tray position detection switch 13 that detects the moving position of the support tray 5, rotatable base's rotation position detection switch 50 that detects the rotation position of the rotatable base 32 on the support tray 5, printing material kind detection switches 64 and 65 that detect the kind of printing object (to be explained in a second embodiment), and encoder 48 are connected to the control section 70, respectively. Output signals of these components are supplied to the control section 70.

Then, the motor 6 for a tray, drive motor 45 for a rotatable base, thermal head 58, and drive motor 60 for a carriage are connected to the control section 70 via a drive circuit 70, a drive circuit 76, a drive circuit 77, and a drive circuit 78, respectively.

An explanation will be next given of print processing of the printing apparatus with reference to the flowchart of FIG. 14. This print processing shows a case in which printing is performed to two areas P1 and P2 on the optical disk 100a as shown in FIG. 2.

The support tray 5 is drawn to the outside of the printing apparatus by the eject operation, and the optical disk 100a is set and moved into the apparatus. Also, character strings to be printed to two portions on the optical disk 100a are input from the keyboard of



the personal computer 68. Then, when printing is instructed from the personal computer 68, print data corresponding to the input character strings is generated by the personal computer 68 (step S1), and print data for performing printing to the area P1, a first portion on the optical disk 100a is transferred to the printing apparatus (step S2). Moreover, a  
5 print start command is transferred to the printing apparatus from the personal computer 68 (step S3).

The printing apparatus stores the print data for the area P1, i.e. a first portion received from the personal computer 68 to the RAM 73 (step S4), and performs print processing to the area P1, i.e. the first portion on the optical disk 100a upon reception of the print start  
10 command.

More specifically, the control section 70 of the printing apparatus drives the motor 60 for a carriage forward, so that the thermal head 58 is moved to the print position that abuts against the label surface of the optical disk 100a. The control section 70 transfers print data stored in the RAM 73 to the thermal head 58 one line by one as moving the carriage 56  
15 from the home position along the moving path. The control section 70 performs thermal printing for a first portion to the label surface of the optical disk through the ink ribbon by driving the thermal head 58. At the print time, on the upper surface of the support tray 5, the cushion sheet 61 having the size corresponding to the moving range is provided on the area corresponding to the moving range of the thermal head 58. For this reason, when the  
20 heat element row of the thermal head 58 presses against the label surface of the optical disk 100a, the thermal head 58 comes in contact with the surface of the optical disk 100a uniformly because the cushion sheet 61 is elastically deformed equally in the direction in which the heat element row is, so that satisfactory printing is performed. When the thermal head 58 ends printing of all print data for the first portion, the control section 70  
25 stops the drive of the thermal head 58 and drives the drive motor 60 for a carriage reversely, so that the thermal head 58 is moved from the label surface of the optical disk 100a to a

non-print position and the carriage 56 is moved to the home position.

Then, when the carriage returns to the home position, the drive motor 60 for a carriage is stopped, so that the first print operation is ended. When the printing ends, the printing apparatus sends a print end command to the personal computer 68 (step S6).

5       The personal computer 68 that has received the print end command sends a rotation instruction command of support tray 5 to the printing apparatus (step S7). Next, the printing apparatus drives the drive motor 45 for a rotatable base to rotate the rotatable base 32 clockwise. Then, when the rotatable base 32 rotates by a predetermined angle, the drive of the drive motor 45 for a rotatable base is stopped (step S8). Here, the predetermined  
10 angle is 180°. Namely, as mentioned above, on the outer peripheral surface of the rotatable base 32, the concave portions 51 are formed at 90 degrees intervals, and after the rotatable base's rotation position detection switch 50 detects the second concave portion 51, the rotation angle at which the number of output pulses from the encoder 48 reaches a predetermined number is set to 180°. The drive of the drive motor 45 for a rotatable base  
15 is stopped when the rotation angle of 180° is detected based on the signals of the rotatable base's rotation position detection switch 50 and encoder 48.

The rotatable base 32 rotates 180° and thereby the cushion sheet 61, which is positioned at the opposite side of the cushion sheet 61, is placed at the position corresponding to the print operation area of the thermal head 58. This state becomes a  
20 predetermined stop position for the rotatable base 32 where the cushion sheet 61 is positioned to be opposite to the print operation area of the thermal head 58. As mentioned above, at this position, the lower surface of the rotatable base 32, which floats from the support tray 5 by contacting only the convex portion 38 during rotation, abuts against the upper surface of the support frame 5.

25       When the rotation operation of the rotatable base 32 is ended, the printing apparatus sends a rotation end command to the personal computer 68 (step S9).

Upon reception of the rotation end command from the printing apparatus, the personal computer 68 sends print data for performing printing to the area P2, i.e. a second portion on the optical disk 100a to the printing apparatus (step S10), and sends a print start command (step S11).

5       The printing apparatus stores print data for the area P2, i.e. a second portion that has received from the personal computer 68 to the RAM 73 (step S12), and performs print processing of print data for the area P2, i.e. the second portion upon reception of the print start command (step S13). In connection with the this print processing, similar to step S6, the print operation of the printer mechanism is performed to the optical disk 100a that is  
10 held on the rotatable base 32 in a stationary manner. At this time, regarding the optical disk 100a, the print area for a second portion on the optical disk 100a is positioned with respect to the printer mechanism by the rotation processing of step S8. When printing for a second portion on the optical disk 100a ends, the printing apparatus sends a print end command to the personal computer 68 (step S14).

15       After that, the personal computer 68 sends an eject command for ejecting the support tray 5 (step S15). Then, the printing apparatus that has received the command drives the drive motor 6 for a tray to eject the support tray 5 to the outside of the case 1 (step S16). This makes it possible to take up the optical disk 100a having a desired character string on upper and lower areas P1 and P2 that sandwich a circular hole as a center.

20       Here, the direction in which the character strings to be printed on the areas P1 and P2 face may be arbitrarily controlled by a setting operation. For example, let a case be considered where the first print operation is performed to the first print area P1 of the optical disk 100a shown in FIG. 2 in a manner that the upper side of a character string "ABC" comes to the side of the circular hole of the optical disk 100a, and a character string  
25 "EFG" is printed on the second print area P2 of the optical disk 100a with the character string's lower side coming to the side of the circular hole of the optical disk 100a. In the

printing operation to be performed to the first area P1, print pattern data in which the characters in the character string "ABC" are expanded normally in the order of the characters is transferred to the thermal head 58 line by line in that order of the characters when the carriage 56 moves from left to right of FIG. 2 (from upper side to lower side of FIG. 1), thereby printing is performed. In the printing operation to be performed to the second area P2, printing is performed by transferring a print pattern in which the character string "EFG" is expanded in a manner that it is turned upside down and left-side right, to the thermal head 58 line by line. Or, print pattern data in which the characters are laid in the normal order may be expanded, and may be read out reversely and turned upside down when it is transferred to the thermal head 58. Additionally, in the case where the character strings to be printed to the areas P1 and P2 should be both laid out with their upper sides coming to the side of the circular hole, print pattern data in which the characters are laid in the normal order may be generated and transferred to the thermal head 58 in the order of the characters in each printing operation.

15 In addition, the printing apparatus sent the end command to the personal computer 68 every time when print processing and rotation processing ended, and received the start command for next processing from the personal computer 68. However, the printing apparatus may, at first, receive print data for two portions and the print start command from the personal computer 68, and all of a series of processing thereafter may be controlled to be performed by only the printing apparatus. Moreover, a keyboard, a display section, memory of character fonts are provided to the printing apparatus to have the function of accepting data input, the function of editing input data and the function of generating printed data, and thereby all processing and control may be singly performed by the printing apparatus without the need of connecting to the personal computer 68.

25 As explained above, according to the first embodiment, after printing for a first portion is performed to the label surface of the optical disk 100a, the rotatable base 32 on which the

optical disk 100a is mounted is automatically rotated by a predetermined angle to perform printing for a second portion. Accordingly, such a complicated task is not needed that the support tray 5 is ejected to change the direction of the optical disk 100a every time when printing is performed to the other portion subsequent to performing printing to one portion 5 of the label surface of the optical disk 100a. This makes it possible to provide printing to a plurality of portions of the surface of the optical disk 100a easily and efficiently.

Moreover, in this printing apparatus, at the time of performing print processing to the first and second portions in steps S5 and S13, the thermal head 58 and the drive motor 60 for a carriage are driven to perform a print operation. During the print operation, the drive 10 motor 45 for a rotatable base that drives the support tray 5 stops driving, and the support tray 5 is in a stationary state. Further, in step S8, when the support tray 5 is driven to be rotated, the print operation is in a stop state. In this way, printing means and rotation driving means are selectively driven and both are not simultaneously driven and this provides advantages in which peak consumption power of the driving apparatus can be 15 reduced, the scale of the driving power supply source to be mounted on the printing apparatus can be decreased, and the driving power circuit can be made compact at low cost.

(Second embodiment)

An explanation will be next given of the printing apparatus of the second embodiment.

The printing apparatus of the first embodiment was used to perform printing to the 20 label of the optical disk 100a. The printing apparatus of the second embodiment has the function capable of performing printing to both the label of the optical disk 100a and paper material.

Generally, as shown in FIG. 9, the optical disk 100a such as CD-R and the like is contained in a transparent case 100b, and paper material 100c such as a cover, jacket, and 25 the like is further contained in the case 100b. The paper material 100c has a rectangular shape whose one side, which is substantially the same length as the diameter of the disk-like

optical disk 100c

In the printing apparatus of this embodiment, such the optical disk 100a and paper material 100c are used as printing objects. The rotatable base 32 has a circular shape corresponding to the disk-like optical disk 100a, and the support tray 5 has a rectangular shape corresponding to the paper material 100c. Then, at the time of printing the title and the like to the optical disk 100a, the optical disk 100a is mounted on the rotatable base 32, and at the time of printing the title and the like to the paper material 100c, the paper material 100c is mounted on the support tray 5 including the rotatable base 32. FIG. 12 shows a state where the paper material 100c is mounted on the support tray 5 which is ejected from the apparatus, and FIG. 13 shows a state where the support tray 5 on which the paper material 100c is mounted is moved to a predetermined print position in the apparatus.

Then, since the printing apparatus of the embodiment makes it possible to perform printing to a different printing object, the kinds of printing objects are detected to allow print processing to be executed accordingly.

15 Namely, a gate-like frame 63, which is positioned at the back side of the frame 54, is attached onto the base 3 of the case 1. A pair of first and second detection switches 64 and 65 as kind detection means for detecting the kind of printing object is attached to the lower surface of the frame 63. The first and second detection switches 64 and 65 are spaced from each other to have a predetermined distance in a width direction of the case 1. The first detection switch 64 is attached to substantially the intermediate portion of the frame 63, and the second detection switch 65 is attached to the position biased to one end of the frame 63.

20 Then, the optical disk 100a is mounted on the rotatable base 32, and when the support tray 5 is drawn into the case 1 and inserted thereto in this state, the peripheral portion of the optical disk 100a comes in contact with an actuator 64a of the first detection switch 64 as shown in FIG. 8A, so that the first detection switch 64 is turned on. At this time, the

optical disk 100a does not come in contact with the second detection switch 65, and the second detection switch therefore remains being turned OFF. Also, the paper material 100c is mounted on the support tray 5 as shown in FIG. 12, and when the support tray 5 is drawn into the case 1 and inserted thereto in this state as shown in FIG. 13, the peripheral portion of the paper material 100c comes in contact with an actuator 64a of the first detection switch 64, so that the first detection switch 64 is turned on. At the same time, as shown in FIG. 8B, the peripheral portion of the paper material 100c comes in contact with an actuator 65a of the second detection switch 65, so that the second detection switch 65 is turned on. The kind of printing object can be judged by the operational combination of such two detection switches.

FIG. 17 is a flowchart showing print processing of the printing apparatus according to the second embodiment.

In this print processing, either the optical disk 100a or paper material 100c as a printing object is set on the support tray 5. Two portions are preset as printing portions.

First, the printing apparatus receives print data for two portions transferred from the personal computer 68 (step S101), and stores the print data to the RAM 73 (step S102). Sequentially, the printing apparatus receives a print start command from the personal computer 68 (step S103).

The control section 70 of the printing apparatus drives the drive motor 60 for a carriage forward to move the thermal head 58 to the print position abutting against the label surface of the optical disk 100a. The control section 70 transfers print data for the first portion stored in the RAM 73 to the thermal head 58 one line by one as moving the carriage 56 from the home position along the moving path. The control section 70 performs thermal printing to the printing object through the ink ribbon by driving the thermal head 58. After printing, the control section 70 drives the drive motor 60 for a carriage reversely to return the thermal head 58 to the home position (step S104).

At the print time, on the upper surface of the support tray 5, the cushion sheet 61 having the size corresponding to the moving range is provided on the area corresponding to the moving range of the thermal head 58. For this reason, when the thermal head 58 presses against the label surface of the paper material 100c equally, so that satisfactory printing can be performed.

Next, the control section 70 determines the kind of printing object based on the operation states of the first and second detection switches 64 and 65 (step S105). The control section 70 determines that the printing object is the optical disk 100a when the first detection switch 64 is ON and the second detection switch 65 is OFF. While, the control section 70 determines that the printing object is the paper material 100c when both the first detection switch 64 and the second detection switch 65 are ON.

When the printing object is determined as the optical disk 100a in step S105, the control section 70 drives the drive motor 45 for a rotatable base to rotate the rotatable base 32 clockwise in order to perform printing for a second portion to the label surface of the optical disk 100a. After that, when rotating the rotatable base 32 180°, the control section 70 stops the drive of the motor 45 based on signals from the rotation position detection switch 50 and the encoder 48 (step S106).

Then, the control section 70 performs printing for a second portion to the label surface of the optical disk 100a (step S107). When the print processing for a second portion is ended, the control section 70 drives the drive motor 6 for a tray to eject the support 5 to the outside of the case 1, and ends the processing (step S108, END).

When determining that the printing object is the paper material 100c after the end of the printing for a first portion, the control section 70 drives the drive motor 45 for a rotatable base to drive the drive motor 6 for a tray without rotating the support tray 5 180°, and ejects the support tray 5 to the outside of the apparatus (step S109).

The user extracts the paper material 100c from the ejected support tray 5, and rotates



the paper material 100c 180° manually in the horizontal plane to change the direction. In this state, the user mounts the paper material 100c on the support tray 5 again to make preparations for printing for a second portion.

After that, a standby state for print restart instruction is set. For example, when  
5 judging that that the print restart is instructed by the eject switch operation done by the user (step S110), the control section 70 drives the drive motor 6 for a tray to pull the support tray 5 to the print position of the apparatus (step S111). After the support tray 5 moves to a predetermined position of the apparatus, the control section 70 performs print processing for a second portion in the same way as the print processing for a first portion (step S112).  
10 When the print processing for a second portion is ended, the control section 70 ejects the support tray 5 to the outside of the apparatus and ends the processing (step S113, END).

In the printing apparatus of the second embodiment, since the printing area is set to a plurality of portions of the label surface of the optical disk 100a, the optical disk 100a is driven to be rotated in the apparatus. Moreover, in terms of the structure in which printing  
15 means and rotation driving means are selectively driven, the same effect as the printing apparatus according to the first embodiment can be obtained.

It is assumed that when the size of one size of the paper material 100c is substantially the same as the diameter of the optical disk 100a, the rotatable base 32 is rotated in the case  
1 to change the direction of the paper material 100c automatically to deal with the printing  
20 to a plurality of portions after the printing to one portion is ended. In this case, a rotation diameter of the rectangular paper material 100c is equal to the length of a diagonal line, and the length becomes larger than the diameter of the disk-like optical disk 100a. For this reason, there is a need to increase the size of the support tray 5 that supports these two printing objects and the size of the case 1 that contains in consideration of the rotation of the  
25 square paper material 100c, with the result that the entirety of the printing apparatus will be enlarged.

However, in the printing apparatus according to the second embodiment, the rotatable base 32 is rotated in the case 1 to change the direction automatically on only the case of the disk-like optical disk 100a. In the case of the rectangular paper material 100c, the support tray 5 is ejected to change the direction manually every time when one printing ends. For this reason, the width of the support tray 5 is made a little larger than the diameter of the optical disk 100a, thereby eliminating the need for increasing the size up to the length of the diagonal line of the paper material 100c, so that the entirety of the printing apparatus can be miniaturized.

Additionally, before the printing is started, the support tray 5 is ejected to the outside of the apparatus by the eject operation to set the printing object on the support tray 5. At this time, the rotatable base 32 is rotated in the apparatus in advance and placed at a predetermined stop position based on the signals from the rotation position detection switch 50 and the encoder 48, thereafter being moved to the outside of the apparatus.

As a result, even if the rotatable base 32 is rotated by some external forces and detached from the predetermined stop position, it is possible to place the rotatable base 32 at the predetermined stop position by this positioning process at the time when the printing object is set.

#### (Third embodiment)

An explanation will be next given of the printing apparatus having the apparatus structure which is appropriate to the use in a vertical position.

FIG. 18 is a perspective view showing the entirety of a printing apparatus according to this embodiment. FIGS. 19 and 20 are a side view and a front view, each showing the structure of the main parts of the printing apparatus.

This printing apparatus includes a box-shape case 101 with the shorter side at the top as an apparatus main body. On both outer side surfaces of the bottom of the case 101, there is formed a leg portion 102 to stabilize placement to an installing surface. The case

101 is installed uprightly on the installing surface with the leg portion 102 at the bottom.

A base 103 is provided in the case 101, and a tray 121, which supports an optical disk 170 as a printing object, is provided on the base 103. Moreover, in the case 101, there is provided a printer section 135 that performs printing of title and the like of data recorded on  
5 the optical disk 170 to the surface (label surface) of the optical recording medium supported by the tray 121.

The tray 121 has a rectangular plate-like tray main body 122. At one side surface of the tray main body 122 to be used as a disk support surface 123 that supports the optical disk 170, there is provided a rotatable base 125, which is rotatable around a rotating shaft  
10 124 and which supports the optical disk 170.

The rotatable base 125 is formed to have a circular shape corresponding to the shape of the optical disk 170. A cushion sheet 126 is adhered to the surface of the rotatable base 125 that abuts against the optical disk 170. At the central portion thereof, a plurality of engaging claws 127a, which engage with the inner periphery of a circular hole 171 of the  
15 optical disk 170, is formed to be projected from the surface of the rotatable base 125. Also, on the peripheral portion of the cushion sheet 126, a plurality of engaging claws 127b, which engage with the outer periphery of the optical disk 170, is formed to be projected from the surface of the rotatable base 125. When engaging with the optical disk 170, these engaging claws 127a and 127b have a projection height to such a degree that they do not  
20 project through the label surface of the optical disk 170. The engaging claws 127a and 127b engage with the optical disk 170, and the optical disk 170 is thereby held by the rotatable base 125.

The tray 121 is placed in the case 101 with the shorter side at the top in a state that the disk support surface 123 is directed substantially vertically. The tray 121 is guided along  
25 guide rails 104a and 104b provided on the base 103 at upper and lower positions in the case 101. The tray 121 is provided to be movable between a predetermined containing position

in the apparatus that performs printing to the optical disk 170 and an eject position, which is the outside of the apparatus, where the optical disk 170 is attachable and detachable.

A rack 128 is provided at the side edge of the lower side of the tray main body 122. In the case 101, there is provided a stepping motor (tray driving motor) 107 that rotates a drive gear 105 forward and reversely through the drive gear 105, which meshes with a rack 128, and a gear train 106. Then, the motor 107 is driven in one direction by the operation of an eject button 109 provided on a front panel 108 of the case 101, so that the tray 121 placed in the apparatus is ejected to the outside of the apparatus from an opening portion 110 formed at the front surface of the case 101. Moreover, the motor 107 is driven in the opposite direction by the operation of the eject button 109, so that the tray 121 placed at the outside of the apparatus is moved to the containing position in the apparatus.

Additionally, in the case 101, there are provided position detection switches 111 and 112 which detect the moving position of the tray 121 in the inside and outside of the apparatus. Based on the signals from these position detection switches 111 and 112, the drive of the motor 107 is controlled, so that the tray 121 is controlled to be stopped at a predetermined stop position in the inside and outside of the case 101.

Moreover, at the back end portion of the tray main body 122, there is provided an engaging portion 132 that is engageable/disengageable with/from a hook 113 provided in the case 101. When the tray 121 is contained at a predetermined position in the case 101, the engaging portion 132 is engaged with the hook 113, so that the tray 121 is held to be fixed to the case 101.

When an eject button 109 is operated, a solenoid 114 is driven. As a result, a plunger 115 is sucked, and the hook 113 rotates around a shaft 116 clockwise from the position shown in FIG. 19 to release the engagement between the hook 113 and the engaging portion 132. Sequentially, the motor 107 is driven, so that the tray 121 moved to the outside of the apparatus. After the motor 107 is started, the drive of the solenoid 114 is stopped and the

hook 113 is returned to the position of FIG. 19 by the function of a return spring 117.

Moreover, the motor 107 is driven reversely, so that the tray 121 moves to the inside of the apparatus. Then, the engaging portion 132 abuts against the hook 113, and the hook 113 is engaged with the engaging portion 132. The reason is that since the top ends of both the  
5 engaging portion 132 and hook 113 are inclined, the hook 113 is returned to the original position by the return spring 117 after the hook 113 is pushed by the engaging portion 132 to rotate clockwise.

The rotatable base 125 provided on the disk support surface 123 of the tray 121 has the rotating shaft 124 at its center, and the rotating shaft 124 is rotatably supported by the tray  
10 main body 122 to be rotatable to the tray main body 122. A motor 129, which is provided at the back surface side of the disk support surface 123 of the tray main body 122, is used as a drive source and driving force of the motor 129 is transmitted to the rotating shaft 124, so that the rotatable base 125 is driven to be rotated clockwise.

In addition, the tray main body 122 is provided with a rotation angle detection switch  
15 131, which detects a rotation angle of the rotatable base 125 to control the drive of the motor 129. The detection switch 131 is actuated by projections for a switch operation (not shown) provided on two portions of the outer periphery of the rotatable base 125 to be opposed 180°. The stop position of the rotatable base 125 can be detected by the actuation of the switch 131.

20 Moreover, in the case 101, there is provided the printer section 135, which is placed at the disk support surface 123 of the tray 121 to be opposite to the rotatable base 125 and which is composed of a thermal transfer printer.

The printer section 135 includes a bridge-shape printer frame 136. Leg portions 137a and 137b, which are provided at both end portions of the printer frame 136, are fixed to the  
25 base 103 of the case 101. A vertical frame portion 137c, which is vertically stretched between the leg portions 137a and 137b, is placed to be biased to the front side of the case

101 from the rotation center portion of the rotatable base 125.

The printer frame 136 supports a carriage 141 equipped with a thermal head 142 and forms a running path where the carriage 141 is moved back and forth vertically along the rotatable base 125. A guide shaft 138, which guides the carriage 141 slidably, is provided 5 in parallel with a vertical frame portion 137c. Moreover, a rack 139 and a guide rail 140 are provided along an opposite face side to the rotatable base 125 of the vertical frame portion 137c. The rack 139 meshes with a drive gear 144 provided at the carriage 141 when the carriage 141 runs. The guide rail 140 guides the carriage 141. The carriage 141 is structured in a self-propelling system in which the drive gear 144 is driven by the 10 equipped stepping motor 143 to move back and forth along the rack 139.

A ribbon cartridge 161, which contains an ink ribbon 162 for thermal transfer printing, is attached to the front side of the carriage 141. The ribbon cartridge 161 is replaceable by opening a printer cover 118 provided at the front of the case 101.

Next, the printer section 135 will be further explained based on FIGS. 21A and FIG. 15 21B. FIGS. 21A and 21B correspond to FIGS. 16A and 16B explained in the first embodiment, and the printer section 135 of this embodiment has substantially the same structure as the structure of the printer mechanism of the first embodiment. For the convenience of the explanation, different reference numerals are added to the components common to the printer mechanism of the first embodiment. However, the functions and 20 operations are the same, except the running direction of the carriage. In the explanation set forth below, though some are duplicated, the structure and the operations of the printer section 135 will be briefly described.

The thermal head 142 is provided at the front of the carriage 141. In the carriage 141, there are provided a running drive mechanism of the carriage 141, a head moving 25 mechanism of the thermal head 142, and a winding mechanism of the ink ribbon 162. The stepping motor 143, which is a starting source for these mechanisms and which rotatable

forward and reversely, is attached to the back surface of the carriage 141.

The ribbon cartridge 161 includes a case 163. On the case 163, a concave portion 164 to which the thermal head 142 is inserted. In the case 163, a ribbon supply core 165 and a ribbon winding core 166 are provided. The ink ribbon 162 paid out from the ribbon supply core 165 is guided by a plurality of guide pins 167, and is wound around the winding core 166 through the concave portion 164 where the thermal head 142 is positioned.

In the carriage 141, there is provided an output gear 145 attached to an output shaft of the stepping motor 143, and a large-diameter gear 146a meshes with the output gear 145. Moreover, a small-diameter gear 146b provided coaxially with the large-diameter gear 146a meshes with the drive gear 144 that meshes with the rack 139. The drive gear 144 meshes with the ribbon winding gear 147. Moreover, a ribbon winding shaft 148 is provided coaxially with a rotating shaft of the ribbon winding gear 147 through a one-way clutch (not shown). The ribbon winding shaft 148 projects to the front of the carriage 141 to engage with the winding core 166 of the ribbon cartridge 161.

Moreover, a cam gear 149 is provided in the carriage 141. The cam gear 149 is provided with an arc-shape cam groove 150, which is off-centered against the center of the rotation. Then, a swing clutch 151 is formed between the cam gear 149 and the output gear 145.

The swing clutch 151 is composed of a sun gear 152, which meshes with the output gear 145, and a pair of planet gears 154a and 154b, which mesh with the sun gear 152 and which are supported to be movable in the circumferential direction of the sun gear 152 through an arm 153.

In the carriage 141, there is provided a head arm 155 to which the thermal head 142 is attached to be rotatable around the center of a shaft 156. The head arm 155 is urged anticlockwise by a spring 157 provided at one end side in a tensioned state. Further, the head arm 155 is provided with a pin 158 close to the one end. The pin 158 is slidably

inserted to the cam groove 150 of the cam gear 149.

Next, the operation of the printer section 135 will be explained. In the standby state for the printing operation, the carriage 141 stops at the home position which is around the upper end position in the moving range on the running path which is formed in the vertical 5 direction. As shown in FIG. 21A, the thermal head 142 is in a state where it is located at the print standby position separated from the surface of the optical disk 170.

When the motor 143 is driven forward from this state, the output gear 145 is rotated anticlockwise, and the carriage 141 runs vertically downward along the guide shaft 138 and the guide rail 140 due to the anticlockwise rotation of the drive gear 144 meshing with the 10 rack 139. The ribbon winding shaft 148 is rotated in the ribbon winding direction by the rotation of the ribbon winding gear 147, and the ink ribbon 162 paid out from the supply core 165 is sequentially wound around the winding core 166.

Further, the sun gear 152 of the swing clutch 151 meshing with the output gear 145 rotates, and the planet gear 154a on one side approaches the cam gear 149 and meshes with 15 this. Due to this, the rotation power of the sun gear 152 is transmitted to the cam gear 149, and the cam gear 149 thereby rotates clockwise, and the head arm 155 rotates anticlockwise around the shaft 156. As a result, as shown in FIG. 21B, the thermal head 142 moves to the print position which abuts the optical disk 170.

A tooth omitting portion (not shown) is formed on a part of the periphery of the cam 20 gear 149. When the cam gear 149 is rotated by a fixed angle, the planet gear 154a falls in the tooth omitting portion and runs idle. For this reason, the thermal head 142 is maintained at the print position.

When the motor 143 is further driven forward, since the planet gear 154a is positioned in the tooth omitting portion, the carriage 141 moves vertically downward on the running 25 path and the ink ribbon 162 is wound, with the thermal head 142 maintained at the print position. Then, along with the move of the carriage 141 and the winding of the ink ribbon



162, the heat elements of the thermal head 142 are driven based on the print data to generate heat, sequentially melting ink on the ink ribbon 162. In response to this, the ink is thermally transferred onto the surface of the optical disk 170, and printing of a title and the like is performed to a predetermined print area on the surface of the optical disk 170 within the moving range of the thermal head 142.

Referring back to FIG. 18, an area A on the rotatable base 125 shown by a broken line indicates the position of an area corresponding to a moving range where the thermal head 142 moves when the tray 121 is contained at a predetermined containing position in the case 101. A width W corresponds to a width of a heating element column of the thermal head 142, and a length L corresponds to a distance where the thermal head 142 is movable.

Moreover, an area B shown by a broken line in FIG. 18 indicates a print area, which is a short strip shape, where printing is performed to the optical disk 170 on the area A when the optical disk 170 is supported by the rotatable base 125. This corresponds to the size of the area A.

15 When the carriage 141 moves to the lower end of the moving range and the print operation ends, the motor 143 is driven reversely and the output gear 145 rotates in a reverse direction (clockwise). In accordance with this operation, the drive gear 144 also rotates reversely clockwise, and the carriage 141 starts to move to the home position, which is placed at the vertically upper position, along the guide shaft 138 and the guide rail 140.

20 At this point, since the ribbon winding gear 147 is coupled to the ribbon winding shaft 148 through the one-way clutch, the rotation of the drive gear 144 is not transmitted to the ribbon winding shaft 148. By the reverse rotation of the output gear 145, the sun gear 152 of the swing clutch 151 rotates reversely, and one planet gear 154a separates from the cam gear 149. At the same time, other planet gear 154b comes close to the cam gear 149, and 25 meshes therewith. By this mesh, the rotational power of the sun gear 152 is transmitted to the cam gear 149, and the cam gear 149 rotates reversely anticlockwise.

Then, by the reverse rotation of the cam gear 149, the head arm 155 rotates around the shaft 156 clockwise and is moved up to the print standby position. In addition, the tooth omitting portion (not shown) is formed on a part of the periphery of the cam gear 149.

When the cam gear 149 rotates by a fixed angle and the thermal head 142 returns to the  
5 print standby position, the planet gear 154b falls in the omitting portion and runs idle.

After the planet gear 154b falls in the omitting portion, only the carriage 141 moves to the home position in a state that the thermal head 142 is maintained at the print standby position by the reverse drive of the motor 143.

FIG. 22 is a view showing the relationship of force acting on the carriage 141.

10 It is assumed that mass of the carriage 141 is  $m[\text{Kg}]$ , power by which the thermal head 142 presses the optical disk 170 is  $P$ , reaction force which the carriage 141 receives by power  $P$  is  $N[\text{N}]$ , and a frictional coefficient between the back surface of the ink ribbon 162 and the thermal head 142 is  $\mu$  [-]. Moreover, a frictional coefficient between the carriage  
141 and its running path, that is, among the guide shaft 138, rack 139, and guide rail 140 is  
15  $\mu'$  [-]. Force  $F[\text{N}]$ , which is required to cause the carriage 141 to run vertically downward at the print operation time, is expressed by  $F[\text{N}] > (\mu + \mu') N[\text{N}] - m[\text{Kg}] g[\text{m/s}^2]$ . Here,  $g$  represents acceleration of gravity.

In this way, printing is performed when the carriage 141 moves vertically downward and the mass of the carriage 141 thereby acts on the vertically downward direction. For  
20 this reason, it is possible to reduce force  $F$  that is needed to move the carriage 141.

Accordingly, it is possible to reduce a load on the motor 143 for causing the carriage 141 to run, and the motor 143 can be miniaturized to make it possible to reduce the power consumption at the print operating time.

This printing apparatus is connected to the computer apparatus by a communication  
25 cable, and performs printing to the optical disk 170 upon reception of transfer of print data such as a title and the like relating to data, which is input, edited and recorded on the optical

disk 170 by the computer apparatus.

In this printing apparatus, the area where printing is performed to the optical disk 170 by one print processing is an area shown by a mark B in FIG. 18. When the carriage 141 of the printer section 135 moves along the running path and the terminal head 142 is driven to perform the print operation, the rotational base 125 of the tray 121 stops. Accordingly, the optical disk 170 stands still and is held on the rotational base 125.

In the case where the printing is performed to two portions on the surface of the optical disk 170, when the first printing ends, the motor 129 is driven to rotate the rotational base 125 180°. Then, after the rotational base 125 stops, printing for a second portion is performed. Control of the rotation angle of the rotational base 125 is conducted based on the detection signal from the detection switch 131.

A mark C in FIG. 18 shows the position of the area where the printing for a second portion is performed after the printing for a first portion in the area shown by the mark B.

As shown in the figure, after the first printing ends, the rotational base 125 is rotated 180° to perform second printing, thereby making it possible to provide printing to the position, which is the opposite side of the label surface that sandwiches the circular hole 171 of the optical disk 170.

As explained above, in the printing apparatus according to this embodiment, there is provided the printer section 135, which performs printing in such manner that the tray 121 is vertically placed to support the optical disk 170 in a vertical direction and the thermal head 142 is vertically moved from the upper to the lower against the vertically directed tray 121. This makes it possible to contain the tray 121 and the printer section 135 in the box-shaped case 101 with the small bottom area and the shorter side at the top, so that the installment area for the apparatus can be reduced.

Moreover, the printer section 135 performs printing in such a manner that the thermal head 142 is moved down to the optical disk 170 supported on the tray 121 when the carriage

141 moves vertically downward along the tray 121. For this reason, it is possible to reduce a load on the motor 143 for causing the carriage 141 to run by use of the weight of the carriage 141 at the print operating time. Accordingly, the motor 143 can be miniaturized to make it possible to reduce the power consumption.

5 (Fourth embodiment)

An explanation will be given of the printing apparatus where a carriage moving direction at the print operating time is different as comparing with the third embodiment.

FIG. 23 is a side view showing the structure of the main parts of the printing apparatus according to the fourth embodiment.

10 The configuration of this printing apparatus is the same as that of the third embodiment except that the carriage moving direction at the print operating time is different as mentioned above. Additionally, the same reference numerals are added to the same components as those of the third embodiment.

The printing apparatus of the fourth embodiment also includes the case 100 with the 15 shorter side at the top. The tray 121 is vertically placed in the case 101, the optical disk 170 is supported on the rotatable base 125 in the vertical direction, and the printer section 135 is provided to the tray 121.

In the printer section 135, the home position of the carriage 141 is set to the lower end portion of the printer frame 136. When the carriage 141 moves vertically upward from the 20 home position, the thermal head 142 is moved to the print position to perform printing. On the other hand, when the carriage 141 moves to the upper end portion of the printer frame 136 and the printing ends, the thermal head 142 is moved to the print standby position to move the carriage 141 to the home position.

In the printing apparatus of the fourth embodiment, there is provided the printer 25 section 135, which performs printing in such manner that the tray 121 is vertically placed to support the optical disk 170 in a vertical direction and the thermal head 142 is vertically

moved from the lower to the upper against the vertically directed tray 121. Similar to the third embodiment, since it is possible to contain the tray 121 and printer 135 in the box-shaped case 101 with the shorter side at the top, so that the installment area for the apparatus can be reduced.

5 (Fifth embodiment)

An explanation will be next given of the printing apparatus having the printer section that moves the thermal head horizontally to perform printing.

FIG. 24 is a side view showing the structure of the main parts of the printing apparatus according to the fifth embodiment. The printing apparatus of this embodiment includes the  
10 case 100 with the shorter side at the top. The tray 121 is vertically placed in the case 101, an opening portion is formed on the ceiling surface of the case, and the tray 121 is movable to the outside of the apparatus through the opening portion. The printer section 135 includes the printer frame 136 placed in the case 101 horizontally, and the carriage 141 is provided to be movable along the printer frame 136.

15 In the printer section 135, the home position of the carriage 141 is provided at the right end portion of the printer frame 136 in FIG. 24, and when the carriage 141 moves to the left side, the thermal head 142 is driven. Additionally, the same reference numerals are added to the same components as those of the third and fourth embodiments.

In the printing apparatus of this embodiment, there is provided the printer section 135,  
20 which performs printing in such manner that the tray 121 is vertically placed to support the optical disk 170 in a vertical direction and the thermal head 142 is horizontally moved against the vertically directed tray 121. Similar to the third and fourth embodiments, since it is possible to contain the tray 121 and printer 135 in the box-shaped case 101 with the shorter side at the top, so that the installment area for the apparatus can be reduced.

25 As explained above, according to the present invention, the printing object is supported substantially vertically and printing is performed to the printing object by print

means, so that the shape of the apparatus main body having the support means and print means can be reduced to one with a small installment space. Moreover, the print head is moved from the upper to the lower against the printing object supported substantially vertically to perform printing by thermal transfer printing and the like. As a result, force, which is required to move the print head, can be decreased, and power consumption at the print operating time can be reduced.

The present invention is not limited to the aforementioned embodiments, and applications and modifications may be arbitrarily possible.

For example, the first embodiment explained the example in which the recording medium as the printing object was the optical disk. However, the recording medium as a printing object is not limited to the optical disk, and any recording medium may be possible. For example, it is possible to use a magnetic disk such as a flexible disk, and the like, an optical magnetic disk such as an MO disk, and the like, and optical recording media such as MD, CD-ROM, CD-RW, DVD-ROM, DVD-R, DVD-RAM, DVD-RW, DVD+RW, and the like in addition to CD-R shown as an example of the optical disk.

The aforementioned embodiments explained that the program for executing each operation was stored in the ROM 72 of the printing apparatus. The storage medium of the program is not limited to this and any medium may be possible. For example, other storage media such as an IC card, a memory card, and the like may be used. Moreover, the program is stored in a hard disk of the personal computer 68 or the storage media for external storage, such as a floppy disk, CD-ROM, DVD-ROM, and the like, and the printing apparatus may be controlled through the personal computer 68. Or, the program may be carried by a carrier wave which can be run on a computer to supply the program to the personal computers 68 and 183, so that the printing apparatus may be thereby controlled.

In the aforementioned embodiments, the plurality of convex portions 38 are formed on the lower surface of the rotatable base 32 and the concave portions 39, which correspond to

the convex portions 38, are formed on the support tray 5. However, the structure may be made the other way around. Namely, the plurality of concave portions may be formed on the lower surface of the rotatable base 32 and the convex portions, which correspond to the concave portions, may be formed on the support tray 5.

5 In the aforementioned embodiments, the friction sheet 40 is adhered to the lower surface of the rotatable base 32. However, the friction sheet 40 may be adhered to the upper surface of the support tray 5.

In the aforementioned embodiments, the plurality of convex portion 38 may be formed on the portion, which is the lower surface of the rotatable base 32 and which is subjected to  
10 pressure by the thermal head 58 as shown in FIG. 15. Moreover, a case in which the convex portions 38 are formed on the upper surface of the support tray 5 may be possible.

In the aforementioned embodiments, the printer section was explained as the thermal transfer printer. However, the type of the printer is not limited to this. For example, this may be configured by the ink jet printer.

15 The aforementioned embodiments explained the case in which a main scanning width W of the thermal head 142 was small to the size of the label surface of the optical disk 170. However, this may be one that corresponds to the diameter size of the optical disk 170. Additionally, in this case, since the optical disk 170 is circular-shaped and the printing is performed in this range, the driving range of the heating element column, which drives the  
20 optical disk 170 to the sub-scanning of the thermal head 142, may be controlled.

The aforementioned embodiments explained the thermal head 142 was moved to the tray 121 which was in a stationary state. However, the thermal head fixed at a predetermined position is driven to be heated and the tray, which supports the optical disk, is moved to the thermal head, so that printing may be performed.

25 Various embodiments and changes may be made thereunto without departing from the broad spirit and scope of the invention. The above-described embodiments are intended to

illustrate the present invention, not to limit the scope of the present invention. The scope of the present invention is shown by the attached claims rather than the embodiments. Various modifications made within the meaning of an equivalent of the claims of the invention and within the claims are to be regarded to be in the scope of the present invention.

This application is based on Japanese Patent Application No. 2002-127123 filed on April 26, 2002 and Japanese Patent Application No. 2002-158983 filed on May 31, 2002 and including specification, claims, drawings and summary. The disclosure of the above Japanese Patent Applications is incorporated herein by reference in its entirety.

#### 10 Industrial Applicability

As explained above, according to the present invention, it is possible to provide a printing apparatus with a small installment space.

Moreover, according to the present invention, it is possible to provide a printing apparatus whose consumption power at a print operating time is small.

15 Still moreover, according to the present invention, it is possible to provide a printing apparatus capable of efficiently performing printing to a plurality of portions on the surface of a printing object with a simple apparatus configuration.



## CLAIMS:

1. A printing apparatus comprising:  
support means (5, 121) for supporting a data recordable recording medium  
5 substantially vertically; and  
print means (56, 58, 135) for printing predetermined data to the recording medium supported by said support means (5, 121).
2. The printing apparatus according to claim 1, wherein said print means (135) includes a print head (142) to move the print head (142) substantially vertically along the  
10 recording medium supported by said support means (121), and to drive the print head (142) to perform printing to a predetermined area of the recording medium.
3. The printing apparatus according to claim 2, wherein when said print means (135) moves the print head (142) substantially vertically from the upper to the lower, the print head (142) is driven.
- 15 4. The printing apparatus according to claim 2, wherein when said print means (135) moves the print head (142) substantially vertically from the lower to the upper, the print head (142) is driven.
5. The printing apparatus according to claim 1, wherein said print means (135) includes a print head (142) to move the print head (142) substantially horizontally along the  
20 recording medium supported by said support means (121), and to drive the print head (142) to perform printing to a predetermined area of the recording medium.
6. The printing apparatus according to claim 2, wherein said print means further includes a carriage (141) that is equipped with the print head (142) and that moves along the recording medium supported by said support means (121), and  
25 the print head (142) moves in accordance with movement of said carriage (141), and provides thermal transfer printing of an image based on predetermined print data to a

surface of the recording medium through an ink ribbon.

7. The printing apparatus according to claim 1, wherein said support means (5, 121) further includes:

rotation drive means (45, 129), having a rotatable base (32, 125) for rotating the  
5 recording medium, for driving said rotatable base to be rotated;

print means (56, 58, 135) for performing printing to the recording medium supported  
by said support means (5, 121); and

control means (70) for controlling the operations of said rotation drive means (45, 129)  
and said print means (56, 58, 135),

10 wherein said control means (70) selectively operates said rotation drive means (45, 129) and said print means (56, 58, 135).

8. The printing apparatus according to claim 7, wherein said print means (56, 58, 135) includes a print head (58, 142) that moves as pressing against the recording medium supported by said support means (5, 121) through an ink ribbon to perform thermal transfer  
15 printing,

said support means (5, 121) is movable to a position where the recording medium is attached/detached to/from said rotatable base (32, 125) and a position where printing is performed to the recording medium, which is supported by said rotatable base (32, 125), by said print means (56, 58, 135), and

20 said rotatable base (32, 125) includes a cushion member (61, 126), which abuts against the recording medium, and engaging means (41, 127a, 127b), which engages with the recording medium, on a surface where the recording medium is mounted.

9. The printing apparatus according to claim 8, wherein the cushion member (61, 126) is provided at a position on said rotatable base (32, 125) subjected to pressure by the  
25 print head (58, 142) at the time of printing to the recording medium in a range corresponding to a width of the print head (58, 142) and a length where the print head (58,

142) presses against the recording medium and moves.

10. The printing apparatus according to claim 7, wherein said print means (56, 58) includes a print head (58) that moves as pressing against the recording medium supported by said support means (5) through an ink ribbon to perform thermal transfer printing,

5 said support means (5) includes a support base (5), which supports said rotatable base (32) to be rotatable around a rotation shaft and to be rotatable in an axial direction of the rotation shaft, and urging means (36) for urging said rotatable base (52) to the support base (5),

one of opposing surfaces of the support base (5) and said rotatable base (32) includes  
10 convex portions (38), which project from said one opposing surface and which slide in contact with the other opposing surface opposing to said one opposing surface during the rotating operation of said rotatable base (32) by said rotation drive means (45), around the rotation shaft, and the other opposing surface includes concave portions (39), into which said convex portions (38) are fit at the print operating time by said print means (56, 58),  
15 around the rotation shaft.

11. The printing apparatus according to claim 10, wherein at least one of opposing surfaces of the support base (5) and said rotatable base (32) includes a member (40) having a thickness smaller than a projection height of said convex portion (38), a cushion property, and a friction property.

20 12. The printing apparatus according to claim 7, wherein said print means (56, 58) includes a print head (58) that moves as pressing against the recording medium supported by said support means (5) through an ink ribbon to perform thermal transfer printing,

said support means (5) supports said rotatable base (32) rotatably, and is movable to a position where the recording medium is attached/detached to/from said rotatable base (32)  
25 and a position where printing is performed to the recording medium, which is supported by said rotatable base (32), by said print means (56, 58), and

either one of opposing surfaces of the support base (5) and said rotatable base (32) opposing to each other includes convex portions (38), which project from said one opposing surface and which abut against other opposing surface opposing to said one opposing surface, at a portion subjected to pressure by the print head (58).

5      13. The printing apparatus according to claim 8, wherein a rotating direction of said rotatable base (32) driven to be rotated by said rotation drive means (45) and a moving direction of the print head (58) are opposite to each other in the direction at a print portion.

14. The printing apparatus according to claim 13, wherein said rotation drive means (45) includes a drive motor (45) and a gear train having a worm gear (46) that transmits  
10 power of the drive motor (45) to said rotatable base (32).

15. The printing apparatus according to claim 7, further comprising detecting means (64, 65) for detecting kinds of predetermined print objects supported by said support means (5),

wherein:

15      said support means (5) supports a first print object and a second print object selectively; and

said control means (70) selectively operates said rotation drive means (45) and said print means (56, 58) when said detecting means (64, 65) detects the first print object, and stops operating said rotation drive means (45) and operates only said print means (56, 58)  
20 when said detecting means (64, 65) detects the second print object.

16. The printing apparatus according to claim 15,

wherein the first print object is a disk-like data-recordable recording medium having a predetermined diameter, and the second print object is a rectangular paper material whose one side has substantially a same length as the predetermined diameter.

25      17. A printing method comprising the steps of:

supporting a data recordable recording medium substantially vertically in a printing

apparatus; and

printing predetermined data to the recording medium supported in said supporting step.

18. The printing method according to claim 17, wherein said printing step includes  
5 the steps of:

moving a print head (142) substantially vertically along the recording medium supported in said supporting step; and

driving the print head (142) moved in said moving step to perform printing to a predetermined area of a surface of the recording medium.

19. The printing method according to claim 17, wherein said printing step includes  
the steps of:

moving a print head (142) substantially horizontally along the recording medium supported in said supporting step; and

driving the print head (142) moved in said moving step to perform printing to a  
15 predetermined area of a surface of the recording medium.

20. The printing method according to claim 17, wherein in said printing step, a carriage (141) that is equipped with the print head (142) is moved along the recording medium to move the print head to a predetermined position, and an image based on print data is provided to a surface of the recording medium through an ink ribbon.

21. The printing method according to claim 17, further comprising the step of  
rotating the recording medium up to a predetermined angle in the print apparatus,  
wherein said rotating step and said printing step are selectively executed to perform  
printing to a plurality of portions on the surface of the recording medium.

22. A program that controls a computer to execute:  
25 a step of storing predetermined print data;  
a step of supporting a data recordable recording medium substantially vertically in a

printing apparatus;

a step of moving a print head (142) along the recording medium supported substantially vertically, in a substantially vertical direction or in a substantially horizontal direction; and

- 5 a step of printing the print data to a predetermined area on a surface of the recording medium by driving said print head (142) moved in said moving step.

Fig.1

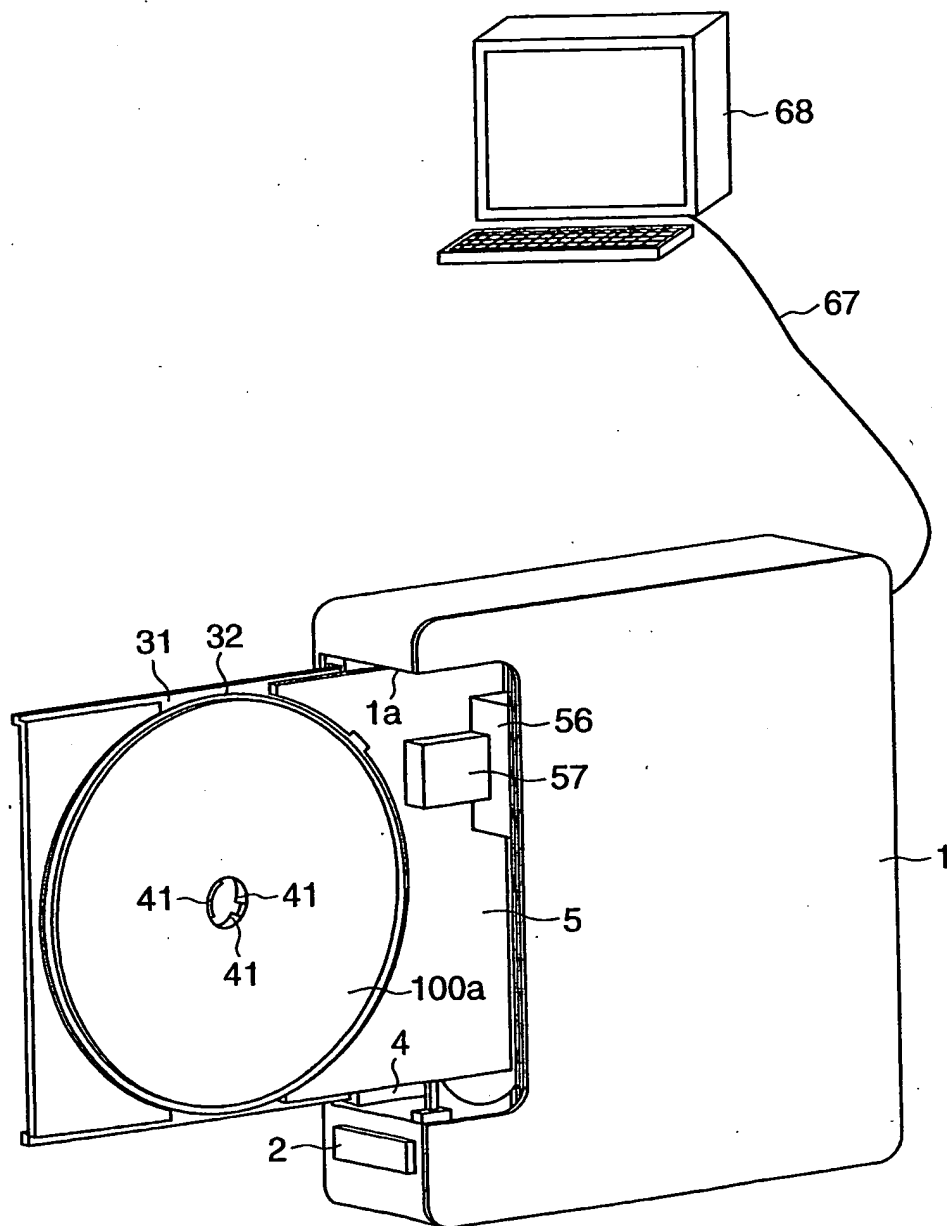
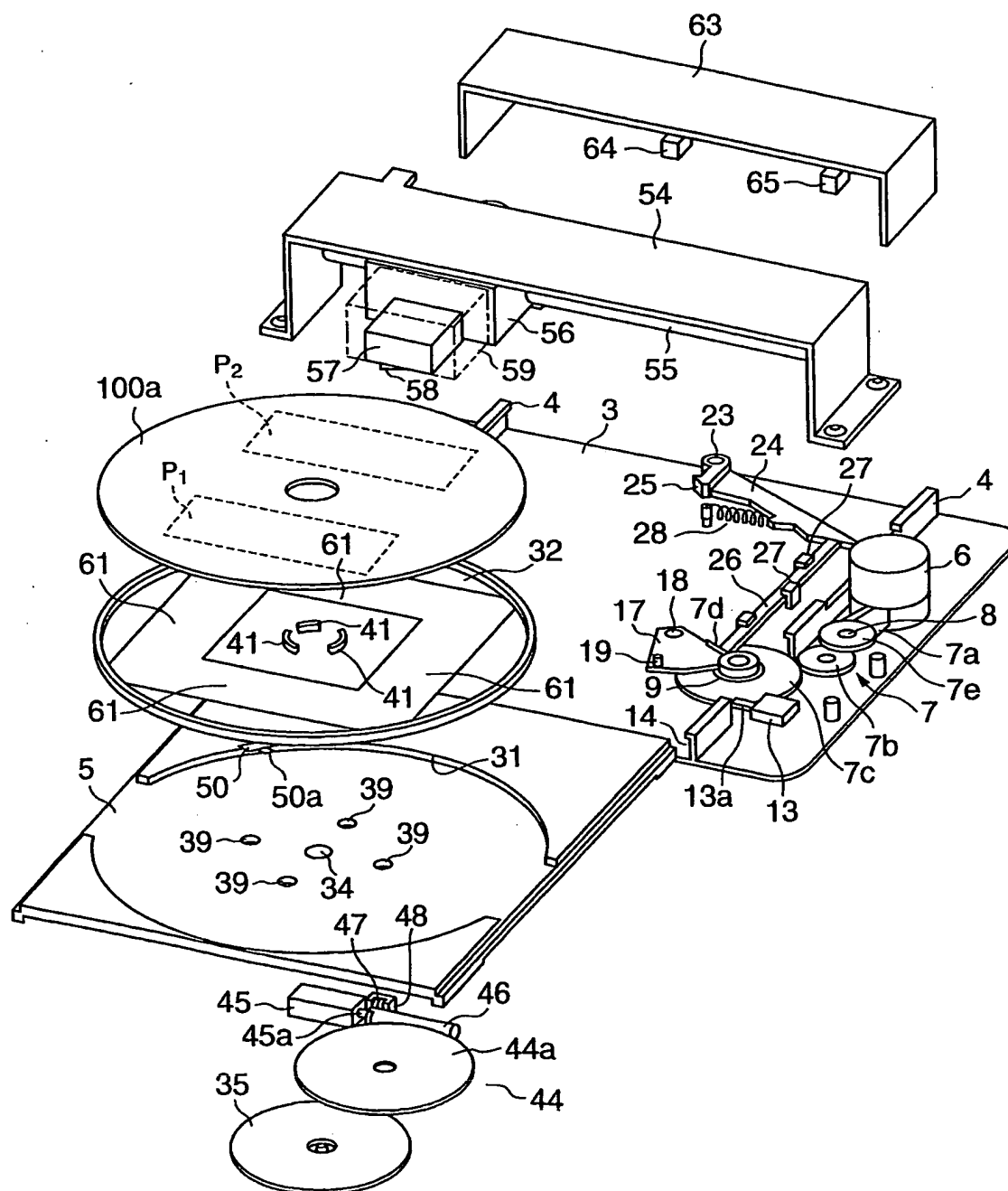


Fig.2





3 / 22

Fig.3

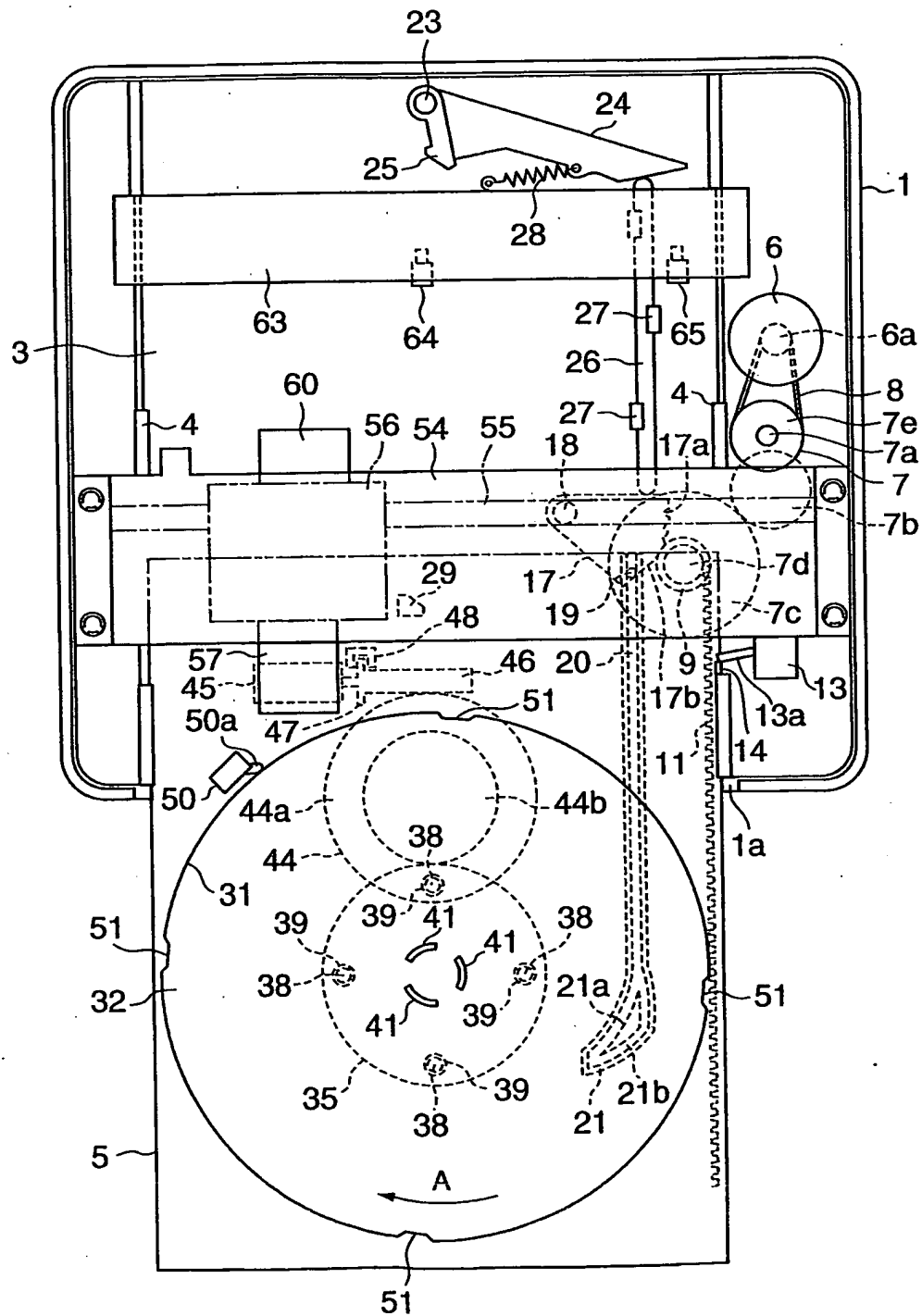


Fig.4

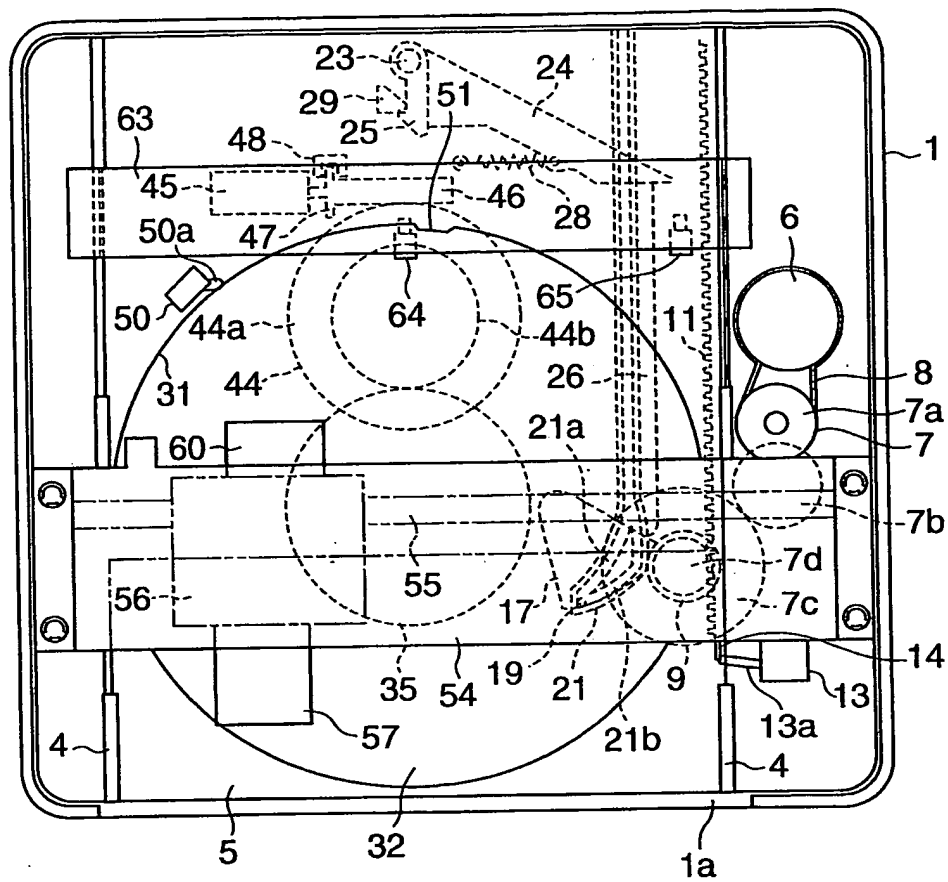


Fig.5

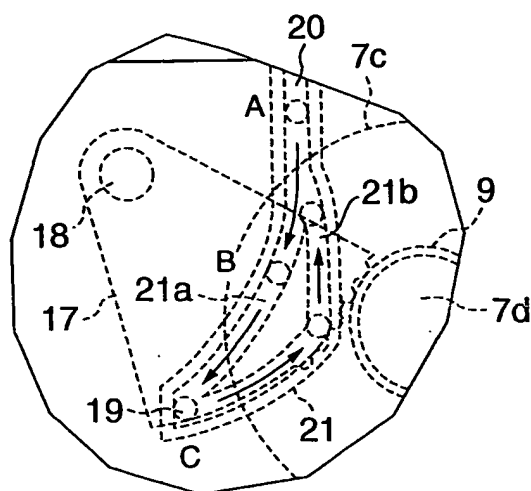


Fig.6A

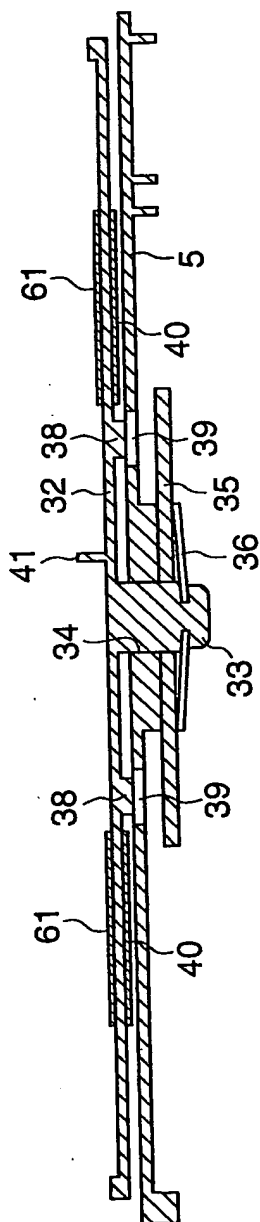
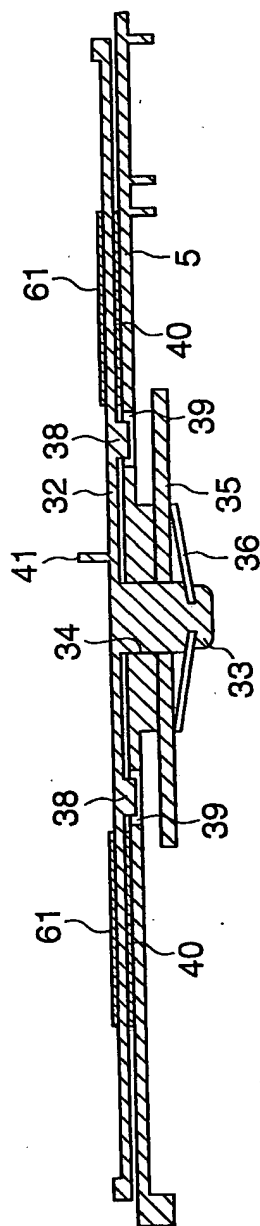


Fig.6B



6 / 22

Fig.7

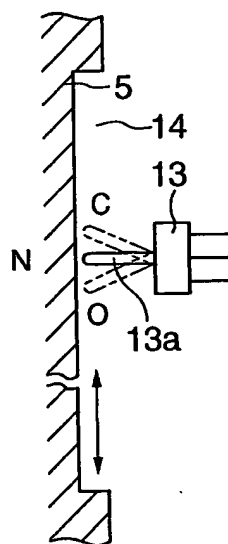


Fig.8A

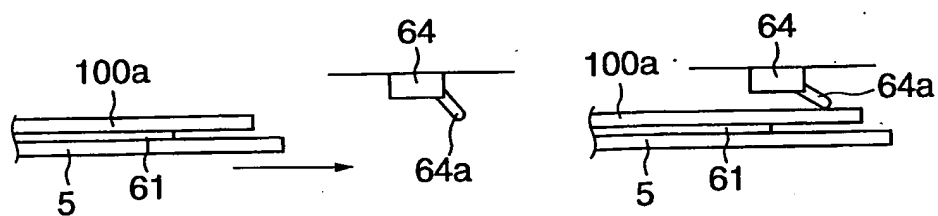


Fig.8B

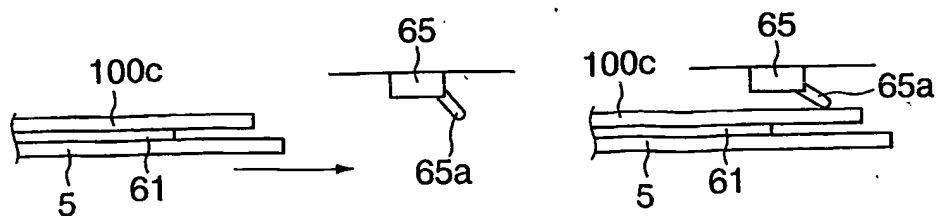


Fig.9

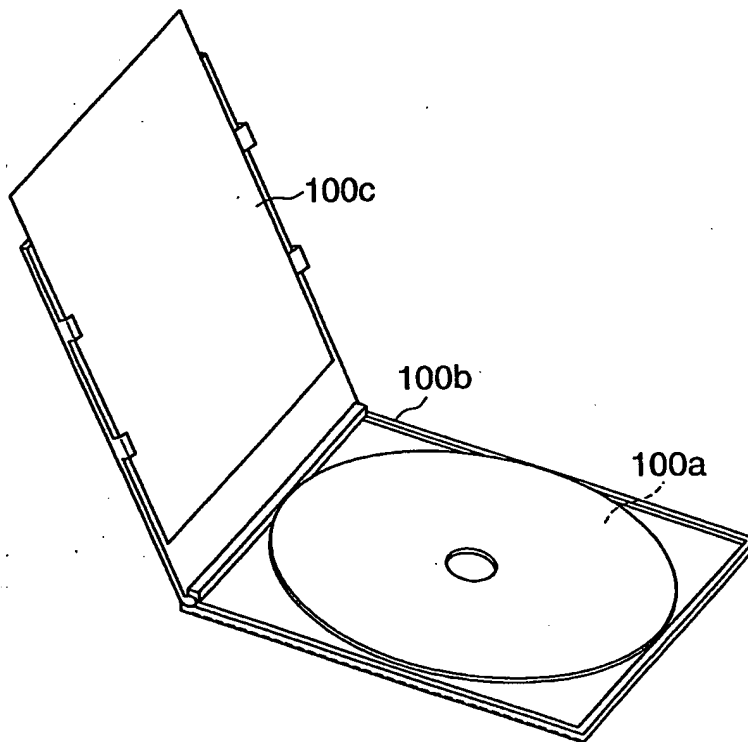


Fig.10

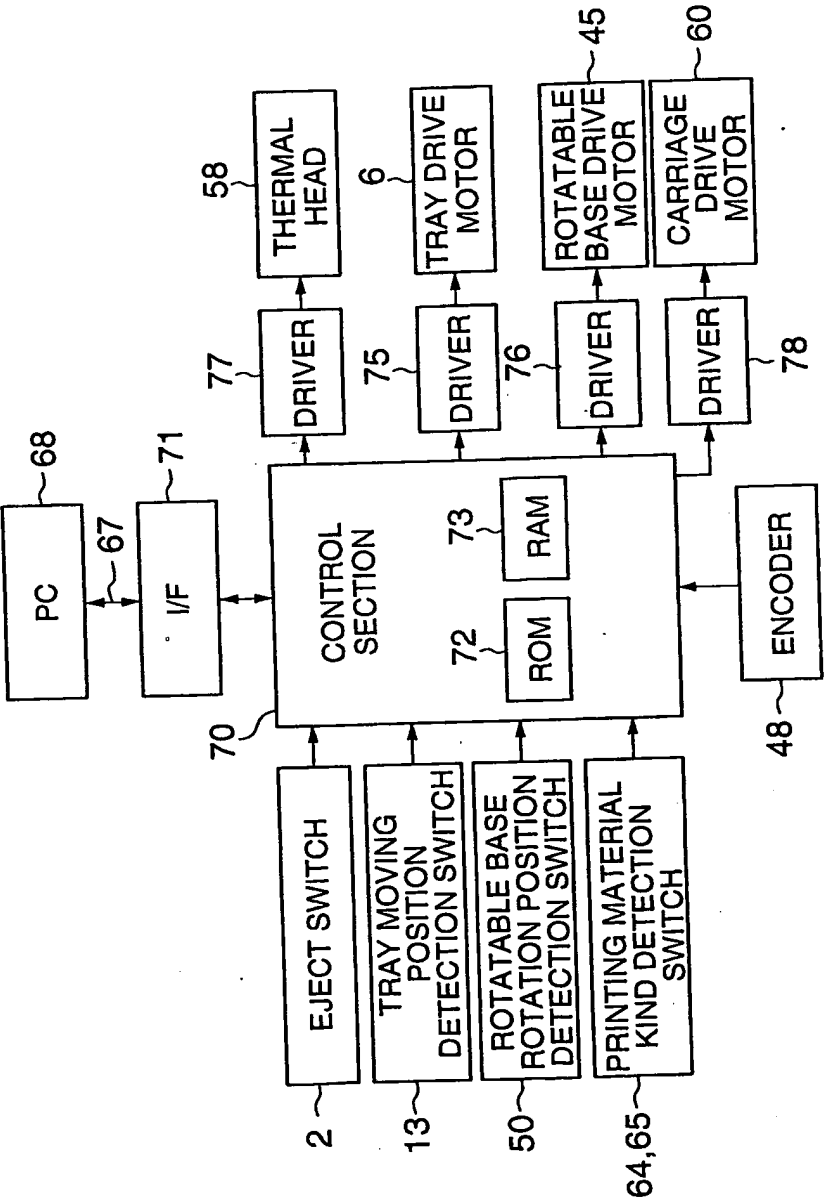


Fig.11A

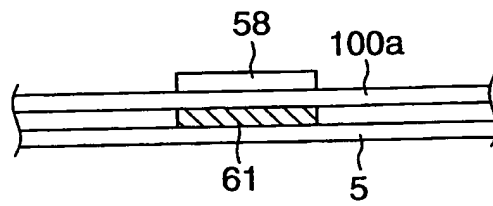


Fig.11B

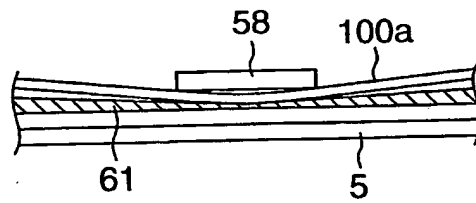


Fig.12

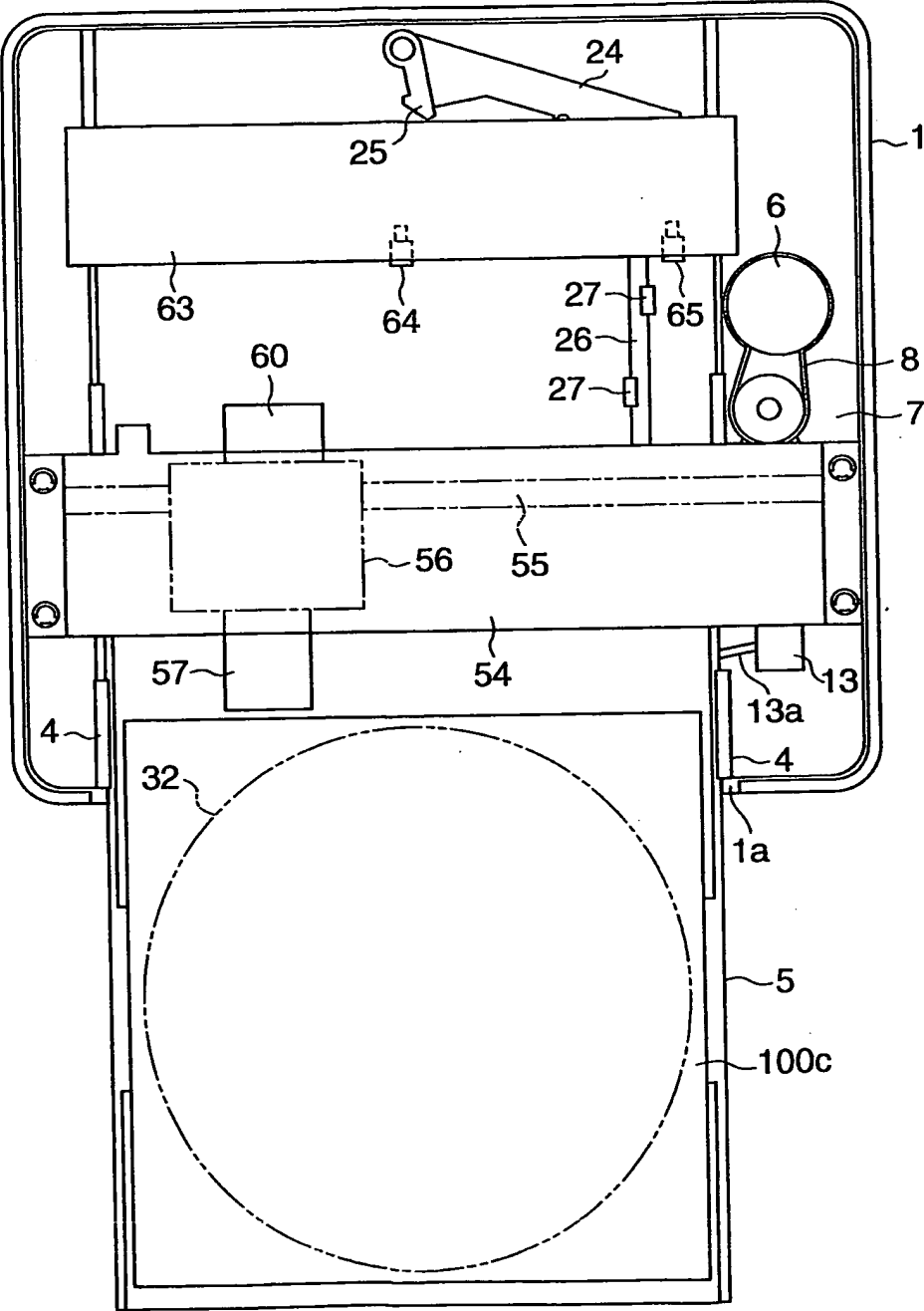




Fig.13

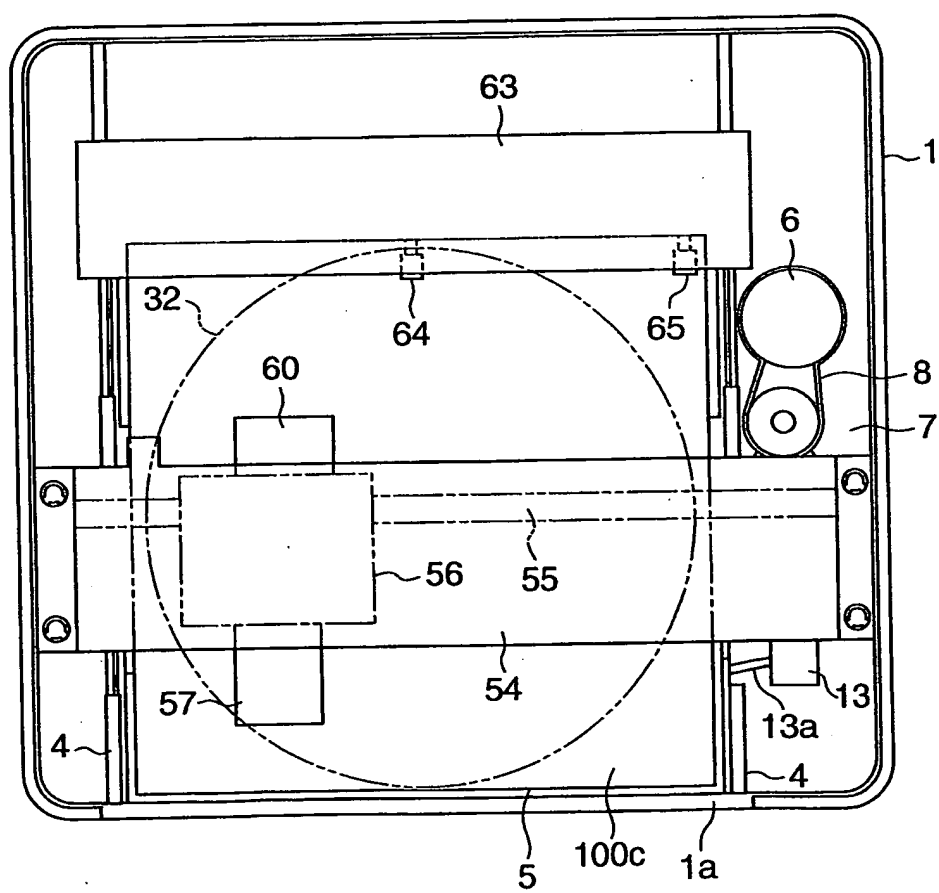


Fig.14

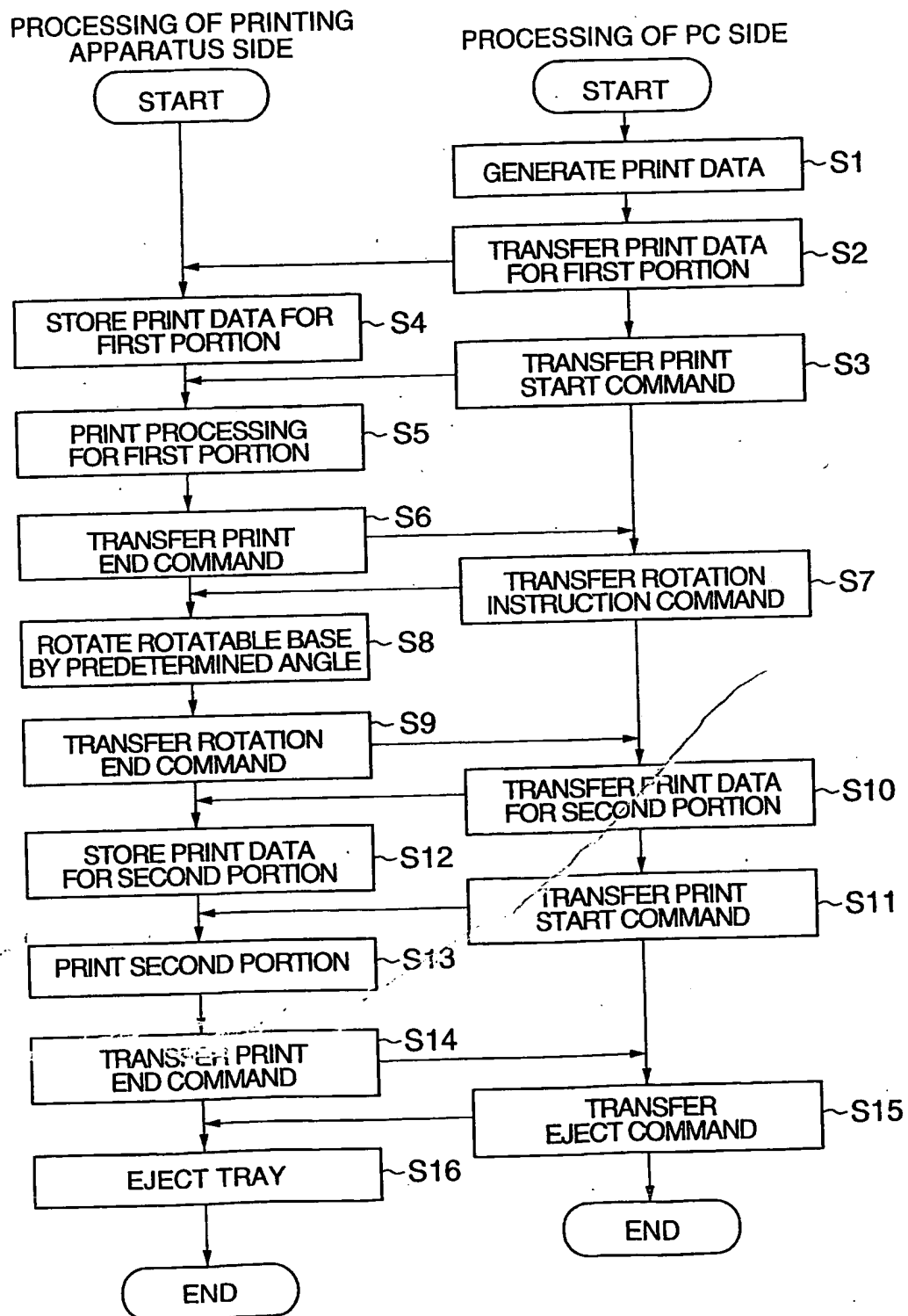


Fig.15

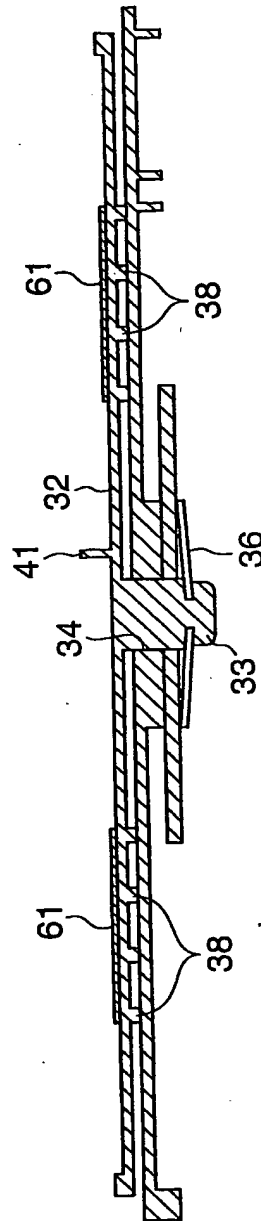


Fig.16A

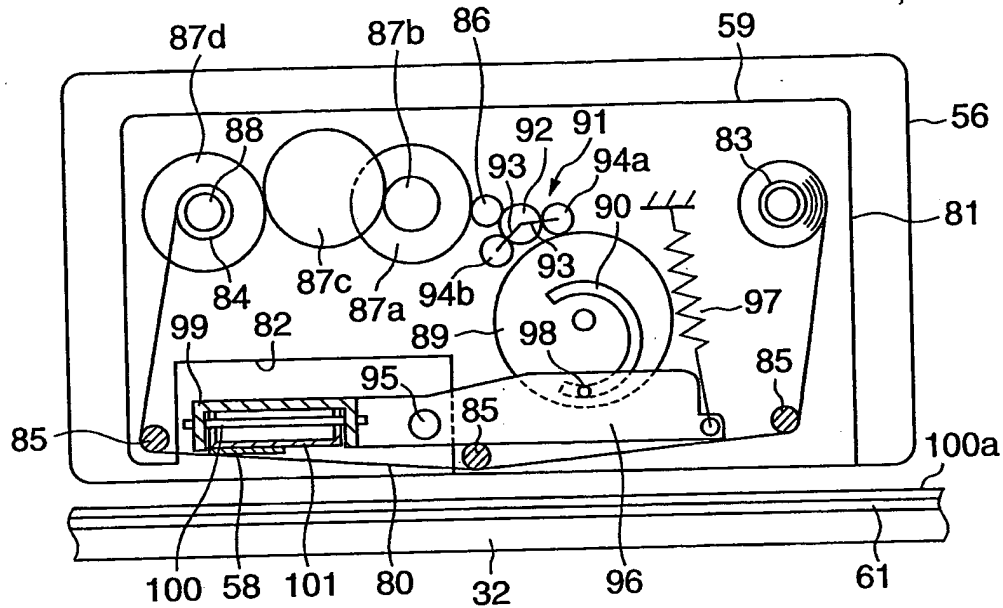


Fig.16B

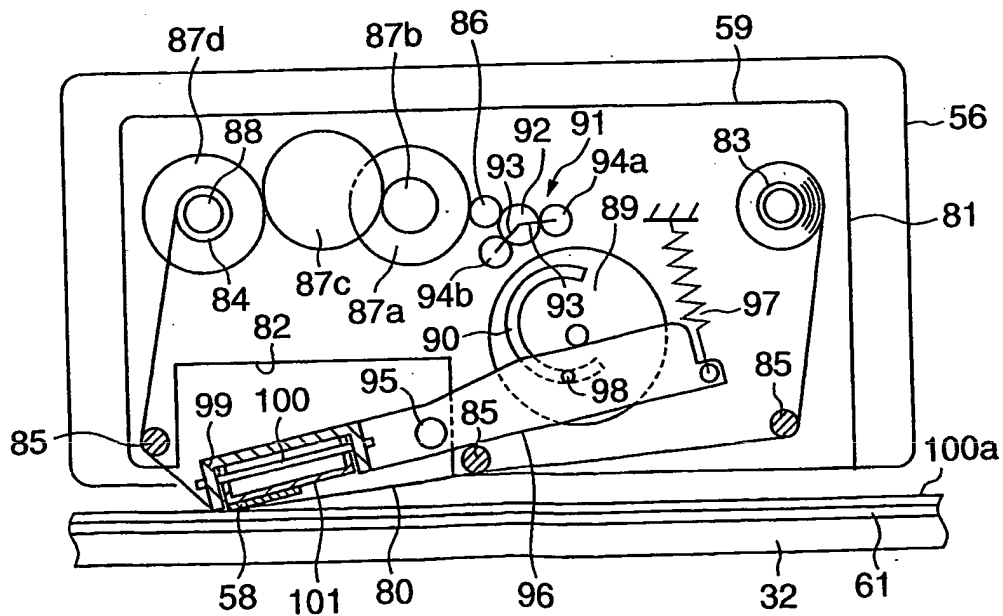


Fig.17

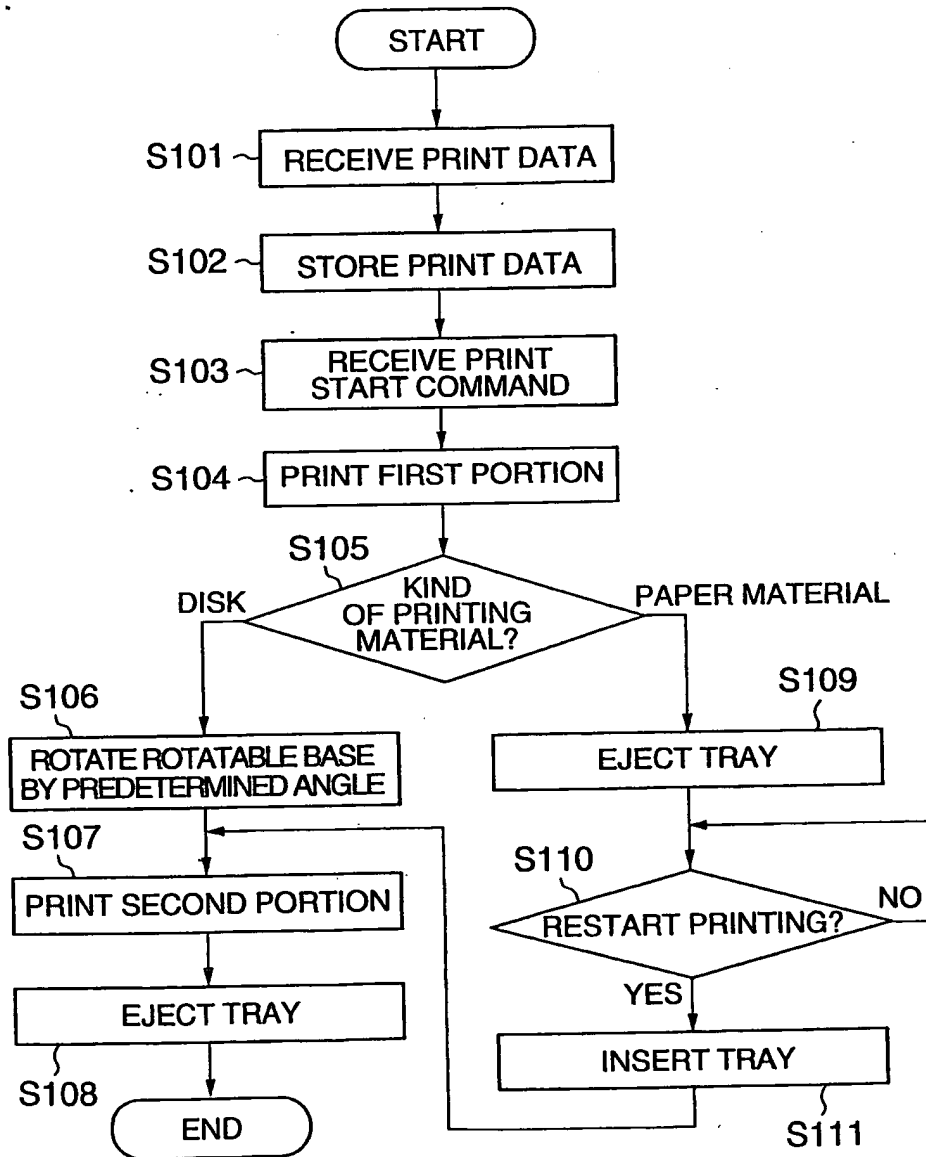


Fig.18

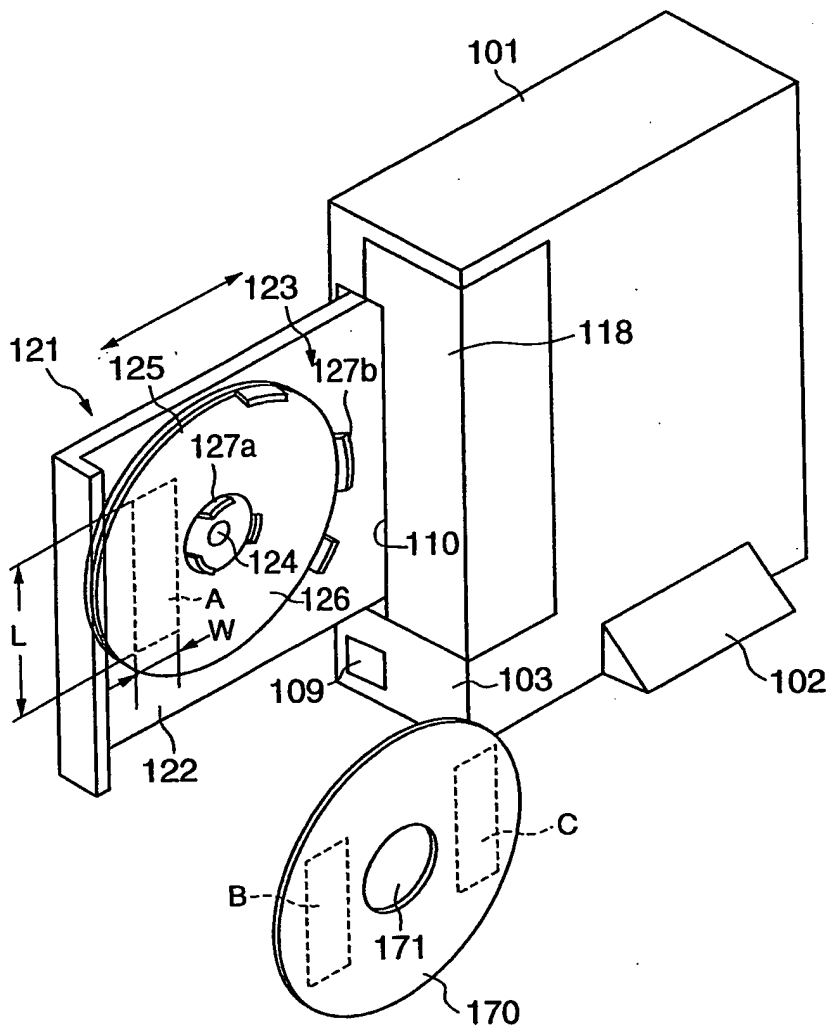




Fig.20

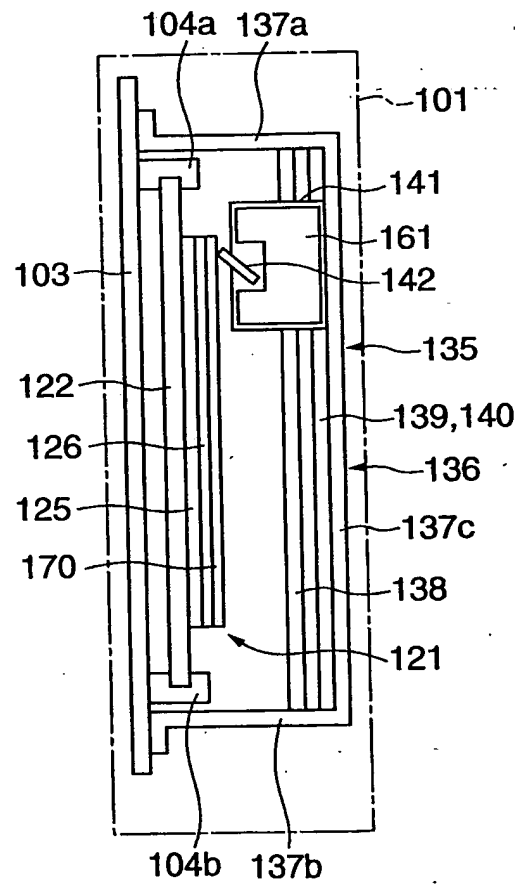




Fig.21B

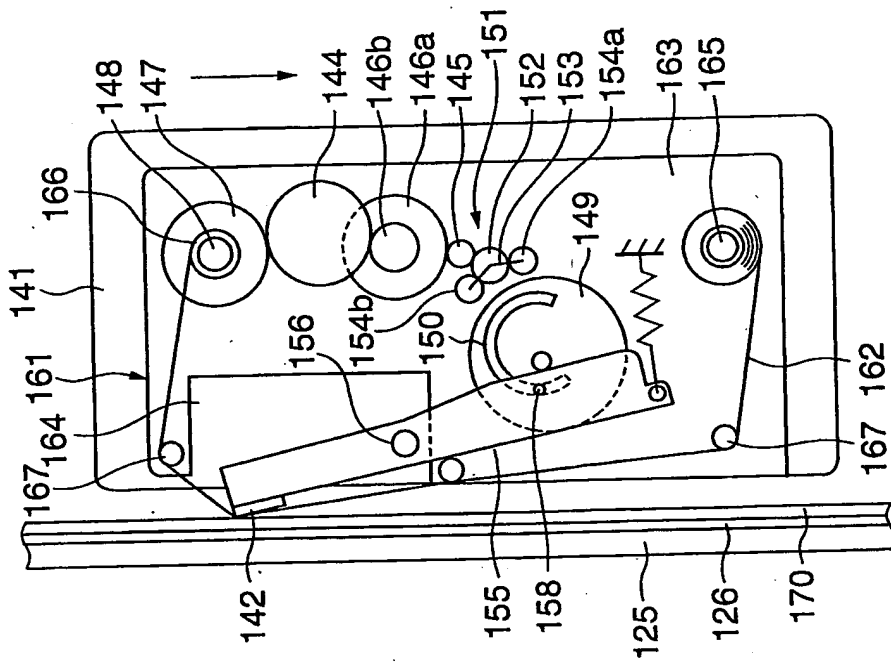


Fig.21A

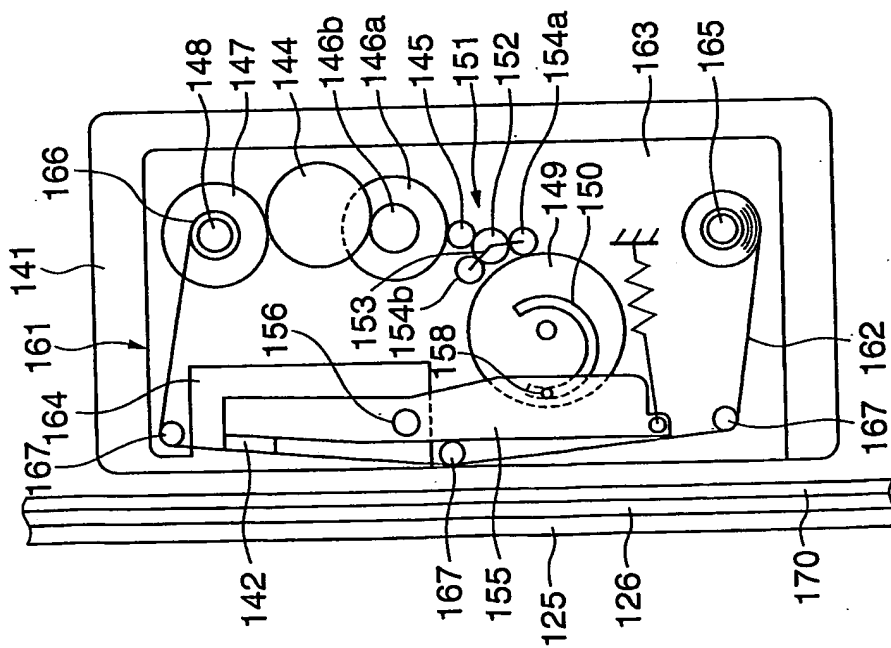


Fig.22

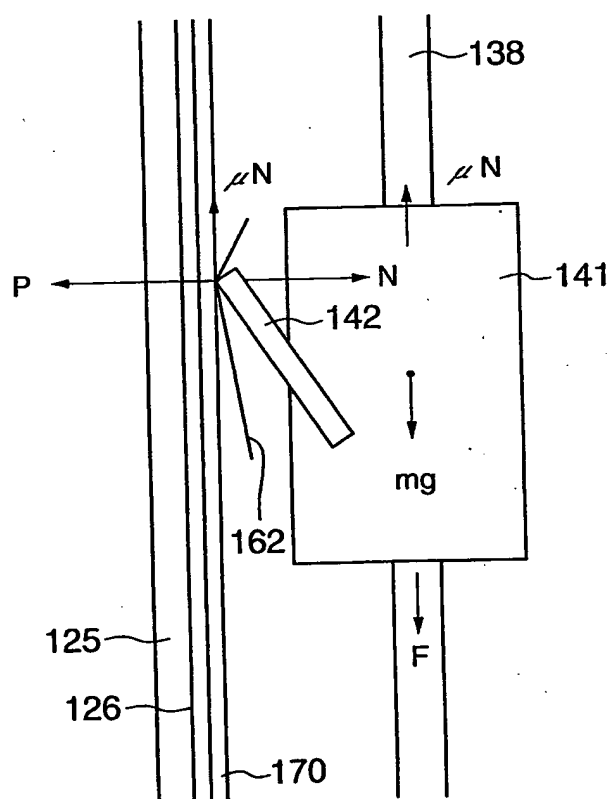


Fig.23

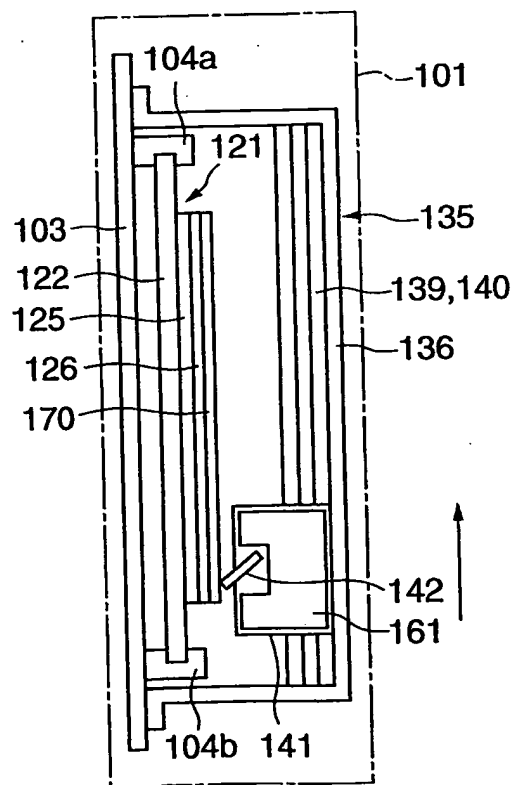
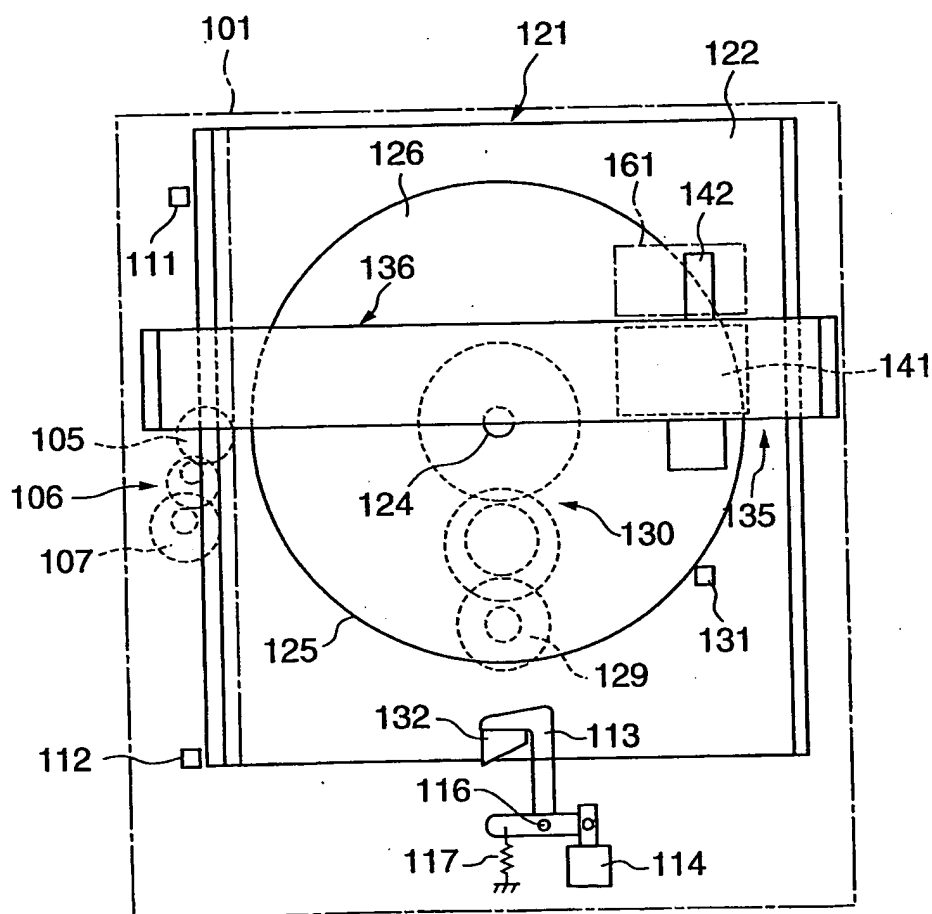


Fig.24



## INTERNATIONAL SEARCH REPORT

International Application No.

PCT/JP 03/05445

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 B41J11/00 B41J3/407

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 947 614 A (MORIO SHUICHI ET AL) 7 September 1999 (1999-09-07) column 1-3; figures 1-5	1-6, 17-20, 22.
A	EP 1 108 550 A (STAR MFG CO) 20 June 2001 (2001-06-20) the whole document	1-22
A	EP 1 018 433 A (EASTMAN KODAK CO) 12 July 2000 (2000-07-12) the whole document	1-22
A	US 6 148 722 A (HAGSTROM ERICK) 21 November 2000 (2000-11-21) the whole document	1-22

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- \*&\* document member of the same patent family

Date of the actual completion of the international search

21 July 2003

Date of mailing of the international search report

30/09/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax (+31-70) 340-3016

Authorized officer

Christen, J

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP 03/05445

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5947614	A	07-09-1999	JP 11105361 A	20-04-1999
EP 1108550	A	20-06-2001	JP 2000071525 A	07-03-2000
			JP 3266867 B2	18-03-2002
			JP 2000225733 A	15-08-2000
			EP 1108550 A1	20-06-2001
			CN 1314845 T	26-09-2001
			WO 0012314 A1	09-03-2000
EP 1018433	A	12-07-2000	US 6202550 B1	20-03-2001
			DE 69903607 D1	28-11-2002
			DE 69903607 T2	26-06-2003
			EP 1018433 A1	12-07-2000
			JP 2000229449 A	22-08-2000
US 6148722	A	21-11-2000	US 6302601 B1	16-10-2001
			US 6447181 B1	10-09-2002
			AU 4424099 A	30-12-1999
			WO 9964242 A2	16-12-1999